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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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EFFECT OF ROENTGEN RAYS ON THE MINUTE VESSELS OF THE SKIN IN MAN*

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IT HAS been recognized for some time that vascular changes (immediate and permanent) may develop after roentgen irradiation. It has seemed to us that too little attention has been directed to the study of the immediate reactions and the influence they may exercise.

Pohle,[1,2,3] one of the few investigators interested in this subject, and Pohle and Bunting[4,5] have described the effect of various types of roentgen rays upon the capillaries of the skin in man and rats. Their observations were that roentgen exposures caused an increase in the number of capillaries, as seen through the capillary microscope. Pohle did not, however, differentiate between capillaries and branches of the subpapillary venous plexus. Moreover, he used the flexor surface of the forearm, where the subpapillary venous plexus is more conspicuous than on the extensor surface, and where it interferes considerably with recording accurate capillary counts.

The present report will record our observations on the minute vessels of the skin in man made following exposure to roentgen rays. Even though the problem as originally conceived could not be completed because of the exigencies created by the war, the observations made thus far seem significant and are presented as a preliminary report with the hope that others may feel that the problem merits further investigation.

METHOD

Roberts and Griffith,[6] and later Griffith, Roberts and Corbit[7] developed a method for following changes in visible cutaneous capillaries which allows one to express results in a rough quantitative manner. They consider the capillaries not in terms of the actual number open and visible, but in terms of the proportion these represent of the total capillaries in that area. The total capillary number is obtained by counting the area after pricking 1:1000 histamine nearby, so that the area under observation is included in the flare. If no change in capillary count is observed after histamine, it is believed that all of the capillaries were open initially. Such an area could not be expected to show an increase in count under any conditions.

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The experimental period included the winter and early spring, but not the warm weather of late spring and summer. The subjects, 84 in number, were adult white patients from the wards of the University Hospital. All were ambulatory, free of demonstrable skin disease, and not in circulatory failure. About 9 A.M., after breakfast, they reported to the laboratory for the capillary counts.

The skin areas studied were on the extensor surface of the forearm, midway between the wrist and elbow, because experience showed that accuracy of the capillary counts was greatest there. The forearm was placed approximately at the level of the lower portion of the sternum to avoid the hypostatic movement of venous pressure. Two areas of about 2 sq. mm. and 4 inches apart were marked on each forearm by inking a circular die and pressing it gently on the skin. The exact area varied somewhat with the tension and elasticity of the skin and the tendency of the ink to run slightly, but, once marked, was constant for the duration of the experiment. Each circle was covered with cedar oil and observed through a microscope with an "Ultrapak" attachment. The capillaries in the marked area were counted and the visibility or nonvisibility of the subpapillary venous plexus noted. When hairs interfered they were clipped with scissors or with a razor held away from the skin surface. The marked areas were protected from trauma by encircling them with "corn pads."

The patients were then sent to the Department of Radiology where one forearm was irradiated and one left untreated as a control.* The total amount of radiation delivered to each patient was approximately the same. The rate of administration and the wave length of the radiation varied. This exposure was begun about 10 A.M. and completed shortly thereafter. At 4 o'clock (six hours later) the capillaries were again counted and the appearance of the field noted. This was repeated at 9 o'clock the following morning. The corn pads were then removed and a drop of histamine, 1:1000, was pricked into the skin with a needle near the area, so that the flare included the region that had been previously studied. At this time a final count was made.

The number of capillaries open and visible after histamine was considered to be 100 per cent of the visible capillaries in the field. The number of capillaries visible at any other observation was expressed as a percentage of this total number. Percentage changes between two counts were obtained by simple addition or subtraction. The percentage change after irradiation was expressed in the capillary count between a treated area and the average of the control areas in the same patient (see the ordinates of Figure 1).

An example may aid in making this clear: Suppose, in a treated area, the capillary count before treatment was 10; five hours after treatment, 18; twenty-four hours later, 12; and after histamine, 20. Thus 20 represents 100 per cent of the capillaries. Therefore 50 per cent were open before treatment, 90 per cent five hours after treatment, and 60 per cent twenty-four hours after treatment. Thus the absolute increase in five hours was 40 per cent, and in twenty-four hours, 10 per cent. But the two control areas showed initial counts of 8 and 12; at five hours 10 and 14; at twenty-four hours 6 and 8, while the counts after histamine were 16 and 20. Thus the control areas had 50 and 60 per cent of their capillaries open originally. After five hours they showed a rise each to 62 and 70 per cent, a gain of 12 and 10 per cent, the average gain being 11. Thus the net increase in the treated area is 40 less 11, which equals 29 per cent. Similarly calculated, the net increase in the treated area in twenty-four hours, when the control change from the initial count averaged minus 16.5, is 10 plus 16.5 which equals 26.5 per cent.

* In an initial series in a score of subjects it was found impracticable to treat with different quantities of radiation or to leave untreated as controls different areas in the same forearm. The lymphatic system of this limb is so rich that injury in one region will affect the capillary counts in others at a considerable distance.

Subjects listed include only those having an initial capillary count of less than 75 per cent of the total number, and in whom technical breaks did not occur. For example, some patients got water on the areas and disturbed the ink markings. Others, for various reasons, were not available for the twenty-four hour count. All these are excluded.

The subpapillary venous plexus was described as being present in those cases in which it was absent before treatment and visible after treatment only in the treated areas and not in the controls.

ROENTGEN EXPOSURE

The patients were divided into four groups, depending upon the physical characteristics of the radiation employed (Fig. 1).

Group I. These patients were irradiated by a Villard type generator, operating at 200 kv. (peak) and 20 ma. The inherent filtration of the oil-immersed tube was equivalent to 0.25 mm. copper. The added filtration was 0.50 mm. copper plus 2.0 mm. aluminum. The target-skin distance was 15 cm. The short distance was chosen to obtain a roentgen-ray beam of high intensity. With these factors the output of the tube was 444 r per minute, measured in air.

The area irradiated was approximately 2 sq. cm. The total amount of radiation delivered to the skin surface at one sitting was 333 roentgens, measured in air.

Group II. The physical characteristics of the rays used in this group were exactly the same as those employed in Group 1. The target-skin distance, however, was 50 cm. At this distance the tube output was 42 r per minute, measured in air.

The area irradiated was approximately 2 sq. cm. The total amount of radiation delivered to the skin surface at one sitting was 301 r, measured in air.

Group III. The physical characteristics of the rays used in this group were exactly the same as those employed in Groups 1 and II, with the exception that the current was reduced to 5 ma. in order to reduce the output of the tube at 50 cm. target-skin distance. Under these conditions the tube output at 50 cm. was 10 r per minute, measured in air.

Group IV. These patients were irradiated by a Chaoul contact therapy apparatus, operating at 50 kv. (peak) and 4 ma. The filtration employed was 0.2 mm. of nickel,

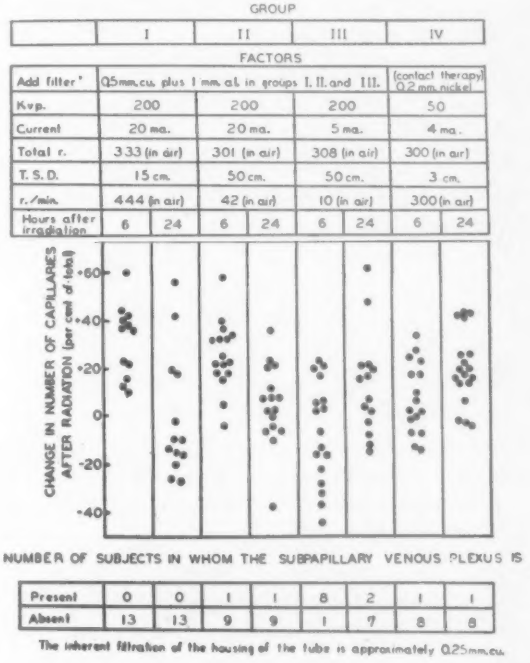

FIG. 1. Chart showing the effect of roentgen rays on cutaneous capillaries under varied conditions. For details see text.

inherent. The half-value layer was 2.4 mm. aluminum. The target-skin distance was 3 cm. The output of the tube at this distance was 300 r, measured in air.

The area irradiated was approximately 2 sq. cm. The total amount of radiation delivered to the skin surface at one sitting was 300 r, measured in air.

It is noteworthy that the patients in Groups 1, II and III were all irradiated by the same machine. The small variations in tube output for the different groups may be attributed to our adherence to the calibration data of the roentgen tube.

SKIN CAPILLARIES AND SUBPAPILLARY VENOUS PLEXUS

The normal appearance of the vessels of the skin of the extensor surface of the forearm is shown in Figure 2. The capillaries

FIG. 2. Appearance of the capillaries and subpapillary venous plexus in the normal skin of the extensor surface of the forearm. Camera lucida drawing in natural colors.

show only at their tips, where they appear as short arcs or red "commas," while the subpapillary plexus shows as somewhat longer vessels following a more varied course. The general color of the background of the skin is yellow. Figure 3 shows the same area after maximal vascular dilatation.* The same vessels can still be descried but many more have been added, both capillaries and venous plexus. In fact, the vessels of the plexus are so numerous that an accurate count of the capillary tips is difficult. The general background is red. Both drawings were made using the camera lucida. The procedure was too long to record the more transient vascular change following histamine.

* Maximal dilatation was produced and maintained by burning the skin nearby with a red-hot glass rod. This was repeated several times at various points around the area of observation. Dilatation by histamine is not maintained long enough to make such a drawing.

RESULTS

In Group I (333 r delivered in ¾ minute at 200 kv. (peak), 15 cm. target-skin distance) a significant dilating effect on the skin capillaries was observed after six hours, which was largely gone after twenty-four hours (Fig. 1).

In Group II (301 r delivered in 7.2 minutes at 200 kv. (peak), 50 cm. target-skin distance) a distinct dilating effect was observed six hours after exposure which was still present, but to a lesser degree, at the end of twenty-four hours (Fig. 1).

In Group III (308 r delivered in 30.8 minutes at 200 kv. (peak), 50 cm. target-skin distance) there was no significant change seen in the skin capillaries after six hours and no very definite effect in twenty-four hours.

In Group IV (300 r delivered in 1 minute at 50 kv. (peak), 3 cm. target-skin distance) a moderate capillary effect was observed at the end of six hours which became more marked after twenty-four hours.

The responses of the subpapillary venous plexus to irradiation were also observed and recorded. It is noteworthy that Group III,

FIG. 3. Appearance of the capillaries and subpapillary venous plexus in the skin of the extensor surface of the forearm after maximal dilatation following a burn. Camera lucida drawing in natural colors.

which showed the least effect on the capillaries, showed the greatest effect upon the subpapillary venous plexus. The significance of this observation is uncertain. However, some suggestions may be offered.

The blood supply of the skin serves a double purpose: (1) it supplies the metabolic needs of the skin and (2) it acts as a vector to dissipate heat from the body as a whole. This first function is supplied mainly by the true capillaries, in which blood flows slowly from the subpapillary arteriolar plexus to the subpapillary venous plexus. As the metabolic needs of the skin are ordinarily small, under normal conditions many of the capillaries do not contain blood and, in some, which do contain red cells, there is no flow. From time to time this situation will change, in that flow will begin in "resting" capillaries and cease in others which had been active.

Much more blood is contained in the subpapillary venous plexus than in the true capillaries of the skin; in fact, it is the blood in the venous plexus which accounts for most of the color of the skin. Only a portion of this blood reaches the venous plexus by way of the capillaries, the greater part passing through the so-called arteriovenous anastomoses. These structures are larger than true capillaries, pursue a much shorter course, lie more deeply, and are well equipped with nerve fibers. They can open or close very quickly, thus admitting or excluding arterial blood from the venous plexus. When all, or nearly all, the arteriovenous anastomoses are open in a given cutaneous area the result is the so-called "capillary pulse," which is really a venous pulse, as blood is admitted with each systole into the subpapillary venous plexus. It is seen especially in subjects with aortic regurgitation or hyperthyroidism, but can be induced in a normal subject by placing the hand in warm water. Arteriovenous anastomoses tend to be open in those conditions necessitating increased heat elimination.

The true cutaneous capillary begins in the subpapillary arteriolar plexus and ends in the subpapillary venous plexus. It thus, at its terminations, lies at the same level as these plexuses and the arteriovenous anastomoses. However, it lies more superficially through the greater part of its course, as it passes to and then away from the skin edge. Thus, if one regards the cutaneous vascular system as consisting of the true capillaries and the subpapillary venous plexus with the arteriovenous anastomoses, which differ from each other both functionally and anatomically, it is not surprising that this complex system varies in its response to stimuli. Whether, for the type of stimuli considered, the difference is due to the amount or depth of injury, or to a neurotropic effect on the arteriovenous anastomoses, is not known at this time.

SUMMARY

Differences in the responses of skin capillaries and subpapillary venous plexuses to irradiation have been observed in man. These seem related to the method of irradiation.

REFERENCES

1. Pohle, E. A. Studies of roentgen erythema of the human skin. I. Skin capillary changes after exposure to unfiltered radiation. *Radiology*, 1926, *6*, 236–245.
2. Pohle, E. A. Studies of roentgen erythema of the human skin. II. Skin capillary changes after exposure to filtered roentgen rays and to ultraviolet radiation. *Radiology*, 1927, *8*, 185–194.
3. Pohle, E. A., and Wright, C. S. Studies of roentgen erythema of the human skin. III. Macroscopic and skin capillary changes after combined exposure to roentgen rays and ultra-violet rays. *Radiology*, 1930, *14*, 351–359.
4. Pohle, E. A., and Bunting, C. H. Skin reactions following exposure to roentgen rays. I. Comparison of effect of two different wave lengths on skin of rats. *Radiology*, 1929, *13*, 496–503.
5. Pohle, E. A. and Bunting, C. H. Skin reactions following exposure to roentgen rays. II. Study of effect of graded doses of two different wave lengths on skin of rats. *Radiology*, 1930, *15*, 647–659.
6. Roberts, E., and Griffith, J. Q., Jr. A quantitative study of cutaneous capillaries in hyperthyroidism. *Am. Heart J.*, 1937, *14*, 598–602.
7. Griffith, J. Q., Jr., Roberts, E., and Corbit, H. O. Studies of criteria for classification of arterial hypertension. I. Cutaneous capillaries. *Am. Heart J.*, 1941, *21*, 47–53.

DETERMINATION OF THE PLACENTAL SITE IN BLEEDING DURING THE LAST TRIMESTER OF PREGNANCY

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BLEEDING in the last trimester of pregnancy frequently indicates placenta previa, or a premature separation of the placenta. In placenta previa a sterile vaginal examination will disclose to the examining finger a boggy mass covering the uterine canal, while in the presence of a negative examination, a premature separation of the placenta should be considered. The vaginal examination, however, has two limitations: (1) a marginal placenta may be beyond reach of the examining finger and yet at delivery may be found to be the cause of severe bleeding; (2) the cervix is not always patulous at this time, because as shown by Ude, Urner and Robbins,[32] the average duration of pregnancy in placenta previa is 252.7 days. When the cervix is not patulous, according to Stander,[28] it is not justifiable to dilate it for this purpose. As a result of these limitations, the existence of a placenta previa cannot always be excluded. Since the maternal mortality in placenta previa, as reported by leading authorities, varies from 1 to 10 per cent, uterine bleeding is always a source of anxiety to the obstetrician. Consequently, any method of determining more accurately the placental site in the last trimester of pregnancy is a welcome addition to the diagnostic armamentarium.

The technique of placental visualization by means of the roentgen rays has been evolved over a number of years. One of the earliest methods recommended was that of amniography by Menees, Miller and Holly[22] in 1930. A water soluble solution of strontium iodide was injected directly into the placental sac through the anterior abdominal wall. The opaque medium mixed with the amniotic fluid so that upon roentgenographic examination the placenta could be visualized within the uterine cavity. The method was found to give satisfactory results in both animals and humans. These authors, with Campbell,[7] made the interesting observation that the fetus swallows the amniotic fluid, with the result that the opaque medium could be seen in the stomach and intestines of the fetus. The method was then used by Kerr and Mackay[19] in 1934, who, following the death of three fetuses, substituted uroselectan B. They found this had a tendency to terminate the pregnancy, but as long as the fetus was viable this was not a serious drawback. The following year a report was made by Burke,[5] who also used uroselectan B. He was able to establish the correct diagnosis in 15 of 23 cases, but in his series he found that the technique caused the patient to go into labor. As a result, he used it as a method of inducing labor, with good results. A series of 6 cases, in which amniography was used, was studied by Cornell and Case.[10] The radiopaque medium, neoskiodan, gave effective contrast, but each placenta was punctured in entering the uterus, with great danger of entering a fetal blood vessel and of subsequent fatal hemorrhage. Unqualifiedly, they advocated the discontinuance of this method because of its inherent dangers. This was the position taken by the medical profession, and amniography was little used, while more accurate and less dangerous methods of placental visualization were introduced.

Before this time, two other methods had been tried with little success. Hewitt[16] is said to have injected lipiodol directly into the placental site but visualization was unsatisfactory. Ehrhardt[13] had injected thoro-

trast into experimental animals and found that the material was picked up by the reticulo-endothelial system of the liver, spleen and placenta. The known dangers of radioactive thorium dioxide discouraged further investigation of this method.

In 1934, Ude, Weum and Urner[31] reported a case of placenta previa diagnosed by the interposition of a soft tissue mass between the fetal head and the bladder, after the injection of opaque material into the bladder. At the same time, they reported 2 other cases of placental visualization. In a later paper, Ude and Urner[30] called attention to the fact that the roentgenologist must be prepared to differentiate a small part of the fetus, such as a hand or a blood clot in the lower uterine segment. These preliminary reports were followed by others more enthusiastic as knowledge of the procedure spread to other clinics. McIver[21] noted that the method carried with it no danger of provoking hemorrhage or introducing infection, and reported 8 cases, all of which were correctly diagnosed, and suggested its wider use by the general practitioner. However, McDowell[20] was able to make a correct diagnosis in only 7 out of 9 cases, using the same technique. Hall, Currin and Lynch[15] studied 40 cases of bleeding in the last trimester of pregnancy. With the exception of 5 cases of breech presentation, all of these cases were correctly diagnosed as to the placental site. This led them to the conclusion that cystography was of value in determining the method of procedure in abdominal or vaginal delivery. Others who reported good results were Prentiss and Tucker[23] with an accuracy of 80 per cent, and Beck and Light[3] who made the correct diagnosis in 88.7 per cent of 71 cases. Air as a means of contrast was used by Prentiss and Tucker[23] who found it to be superior to sodium iodide. In a later report, Ude, Urner and Robbins,[32] the originators of the method of cystography, reported a study of 15 cases. The average distance between the fetal skull and the wall of the bladder was 1 cm. The central type of placenta previa was noted to displace the presenting part upward over the entire upper surface of the bladder, while the partial type was seen as a tendency to depress one of the lateral horns of the bladder and displace the fetal parts to the opposite side. In 44 cases their accuracy was 98 per cent. Friedman and Macdonald[14] reported 2 verified cases of placenta previa with roentgen findings. The lowest percentage of accuracy was that of Carvalho[9] who correctly diagnosed only 13 out of 19 cases of placenta previa. In all the cases where the placenta was not seen by means of a cystogram, the placenta was found implanted on the posterior wall with only the margin or one or two cotyledons overhanging the os. This factor proved to be one of the drawbacks of this method and was emphasized by Dippel and Brown[11] who called attention to the fact that training and experience were needed in interpeting these roentgenograms. It also led Holmes,[17] in a review of the literature, to conclude that it had only a fair degree of accuracy. Arnell and Guerriero,[1] although making no report of their cases or technique of examination, found the cystographic method of diagnosis of little value in placenta previa.

In 1934 Snow and Powell[25] called attention to the fact that the placenta could sometimes be visualized in the lateral view of the abdomen during the last trimester. They reported one case in which the findings were verified at autopsy. To their credit belongs the discovery of the value of direct roentgen visualization of the placenta in cases of possible placenta previa. The study of a soft tissue technique was advanced by Carty[8] who advised the use of: (1) 300 ma-sec.; (2) 36 inch distance; (3) voltage to vary with thickness; (4) intensifying screens and development by sight. In the hands of Snow and Rosensohn[26] it was found possible to demonstrate, in addition to the placental site, polyhydramnios, placental apoplexy and extra-uterine pregnancy by this method. Later, Weintraub and Snow[34] showed that the black line of demarcation seen between the fetus and overlying uterine wall was entirely due to

fetal subcutaneous fat and not to the vernix caseosa. With this technique, Dippel and Brown[12] were able to demonstrate the placenta in 90 per cent of 203 observations. Non-visualization, they found to be due to: (1) hydramnios; (2) twins; (3) immaturity; (4) obesity. Unsatisfactory roentgenograms accounted for 3 per cent. As far as the position of the placenta was concerned, no error was found in 53 cases checked by clinical methods. In a later paper these authors[11] noted that presentation of the fetus should not interfere with the identification of the placenta. We have been able to substantiate this in our series. With this same technique, Buxton, Hunt and Potter[6] were able to localize the placenta in 86.1 per cent of 108 cases. When the placenta was not visualized in the fundus, a cystogram was done using 4 per cent sodium iodide as a contrast medium. With the combined methods, they were able to localize the placenta in 97.6 per cent of cases. There were 17 cases of placenta previa in which the diagnosis was made accurately in 16. Recently, Vaughan, Weaver and Adamson[33] introduced the use of a plastic filter in order to allow the usual amount of radiation to the anterior portion of the abdomen, while the heaviest radiation strikes the region of the pelvis and spine. This method promises to further increase the diagnostic value of the soft tissue technique.

A study of our results during the past four years at the University of Maryland Hospital was made in order to determine the relative value of the roentgen examination. During the period from November 1, 1938 to February 1, 1943, a total of 132 cases were examined. The bleeding varied in amount from an occasional spotting to the passage of large blood clots. These cases were not selected and all were examined by the method to be described, with the following results and clinical course of pregnancy (Table 1).

TABLE I

Roentgen Diagnosis	No.	Clinical Diagnosis	No.	Delivery	No.
A. Placenta previa	2	Central placenta previa	2	Cesarean	2
B. Marginal placenta previa	2	Partial placenta previa	1	Cesarean	1
		Undetermined (i.e. cause of bleeding)	1	Vaginal	1
C. Low implantation (possible marginal)	25	Partial placenta previa	2	Cesarean	2
		Marginal placenta previa	4	Cesarean	2
				Vaginal	2
		Low implantation with partial separation	5	Decapitation and extraction	1
				Vaginal	4
		Low implantation	4	Vaginal	4
		Cervical erosion	4	Vaginal	4
		Undetermined	6	Vaginal	6
D. Negative for placenta previa	101	Negative for placenta previa	98	Vaginal	98
		Possible marginal placenta previa	1	Vaginal	1
		Partial placenta previa	1	Version and Extraction	1
		Central placenta previa	1	Cesarean	1
E. Unknown	2	Partial placenta previa with twins	1	Cesarean	1
		Partial placenta previa with profuse bleeding	1	Willett forceps Voorhees bag	1

It will be seen that in making a positive diagnosis of placenta previa, Group A and B, we were correct in 3 out of 4 cases, or 75 per cent. We are unable to explain the case which was misdiagnosed, as the placenta was present on the anterior uterine

wall and appeared to extend down to and over the internal cervical os. A sterile pelvic examination before delivery and an examination of the placenta after delivery failed to reveal the cause of the bleeding. With more experience in interpretation, we expect our average in this group to improve.

In our reports we have come to consider a low implanted placenta as being a possible marginal placenta previa, Group C. Until some further refinement of technique is made, we do not feel safe in attempting to differentiate between a low implantation of the placenta and a marginal placenta previa. The shape and size of the placenta have a wide range of normal values. In addition to that, the possibility of abnormality of implantation as suggested by Brown and Dippel[4] must be considered, such as a placenta succenturiata, bipartita and spuria. In this group, considering the cases of cervical erosion and bleeding of undetermined causes to have been misdiagnosed, our accuracy was 60 per cent (15 out of 25 correct). These cases were all examined vaginally, both bimanually and by speculum, subsequent to roentgen examination. Then, depending upon the clinical judgment of the obstetrician, the fetus was delivered by vagina or by laparotomy. At the time of section, an attempt was made to determine the location and extent of the placenta and this was noted on the chart. A number of cases delivered by vagina had an amniorhexis performed. After delivery of the placenta, the distance between the incision and the nearest border of the placenta was measured. Consequently, the clinical diagnoses in Group C are very accurate and we were able to make an exact comparison with our roentgen findings. The high number of cases of partial separation, associated with a low implantation of the placenta, has been explained by Torpin.[29] In a study of 144 placentas, he found that there is frequently a rupture of a large decidual vessel when the excess ring of chorionic villi is folded back from the uterine wall to form the infarct ring of placenta marginata.

In Group D, the roentgen method of placenta previa diagnosis was shown to be most accurate: 98 out of 101 cases were diagnosed correctly for an average of 97 per cent. This is in accordance with the view of Beck and Light[3] who found that the method had its greatest value in ruling out placenta previa as a cause of vaginal bleeding. An analysis of our 3 failures showed: (1) One case to have been diagnosed clinically as a possible placenta previa but this was never clearly demonstrated either before or after delivery. (2) In the second patient the placenta was implanted on the midportion of the posterior uterine wall. Despite the fact that the bladder was deviated laterally, this was diagnosed as negative. Vaginal examination showed it to be a partial placenta previa. (3) The third case was grossly misdiagnosed. Re-study of the roentgenogram indicated a definite placenta previa.

Only 2 cases are included in Group E. This is a very low number and indicates that the method is readily applicable to various anomalies of position and presentation of the fetus. These 2 cases, of course, must be considered as failures: (1) One case was that of twins at term, but with no fetal parts entering the pelvis. Despite adequate technique we could not demonstrate the placenta. (2) The second case was that of a young mother admitted with profuse bleeding. The examination was not completed because the patient was on the threshold of shock, consequently we were unable to make a diagnosis.

For the entire group of 132 patients, we have made the correct diagnosis in 87.8 per cent of the cases. Our best results were in making a negative diagnosis in which we were 97 per cent correct. This is important because the obstetrician can then safely allow these patients to go to term and deliver vaginally, without undue fear of a sudden fatal hemorrhage from a placenta previa. Our poorest results were in the diagnosis of low implant and possible marginal placenta previa, with only 60 per cent correct diagnoses; however, to be fore-

warned is to be forearmed. Those relatively few patients out of this group whose diagnosis is not confirmed or disproved by vaginal examination can be placed under strict supervision, so that any untoward development can be handled. Vaughan, Weaver and Adamson[33] point out that in addition to diagnosing placenta previa, the method is of value in that it is possible (1) to demonstrate placenta previa before serious bleeding begins; (2) to know the exact site of the placenta if it becomes necessary to do a cesarean section; (3) to know presentation and position. However, we do not agree with the above authors that vaginal examination may be avoided by this method. Rather, it is an accessory to the vaginal examination and is not intended to supplant the latter. Heed should be paid to the warning of Carvalho[9] that all patients who have a history of bleeding should receive the benefit of a careful vaginal examination under proper precautions. Again, it is only logical that even though a placenta previa be ruled out, the presence of a premature separation or a cervical erosion should be looked for and treated if necessary.

Technique of Examination at the University of Maryland Hospital. All dispensary and private patients are referred to the hospital for admission whenever they report bleeding in the last trimester of pregnancy. If the bleeding is not too severe, the first step is the roentgen examination. All patients are treated as emergencies. As soon as possible, even before the processing of the films is completed, a tentative diagnosis is given to the physician in charge of the patient.

Routinely, two large roentgenograms are taken of the abdomen, in the lateral and anteroposterior positions. It has been stated by Dippel and Brown[11] that a single lateral view will suffice. In the majority of cases this is true, as regards placenta visualization, but in a certain number of cases various pathological conditions in mother or child are apt to be overlooked in the single film technique. In 2 of our cases, the placenta was not visualized in the lateral position but was shown in the anteroposterior view. In addition to this, we have been able to show cholelithiasis, nephrolithiasis, intestinal obstruction, uterine tumor, extra-uterine pregnancy, cephalopelvic disproportion and fetal death as complications of pregnancy in our routine examinations. Also, the exact position and presentation of the fetus is then known, factors which are sometimes of great value in the subsequent treatment.

The technical factors used in our soft tissue examinations are as follows: (1) 300 ma-sec.; (2) 36 inch distance; (3) intensifying screen; (4) Potter-Bucky diaphragm; (5) kilovoltage varies with thickness of the patient; (6) removal of all filtration. This is essentially the original technique recommended by Snow and Powell.[25] The kilovoltage is usually 65 to 75. As has been shown by Weyl, Warren and O'Neill,[35] this relatively low kilovoltage results in better contrast, for as the kilovoltage is increased, the average wave length of the beam is shortened and all tissues are penetrated equally, resulting in less contrast on the exposed film. Removal of the filter aids further in increasing the average wave length of the emergent roentgen-ray beam, with a still greater increase in contrast.

Using the above technique, it is usually possible to visualize the entire uterine wall. A strong source of illumination may be necessary at times to bring this out. The thickness of the uterine wall at term is 1.5 to 2.0 cm. at 36 inch distance. The placenta is noted as a thickening of the uterine wall. In our series of 132 cases, the greatest number were found to be 6 cm. thick with a range of values between 3.5 and 14 cm. when the body of the placenta is located in the fundus and at term. These values are necessarily a function of the tangent of the uterine wall described by the roentgen-ray beam. It has been mentioned by Snow and Rosensohn[26] that the small parts of the fetus almost invariably face the placenta. This has been true in only 79 per cent of our cases; nevertheless, it is of some aid in locating the placenta, but cannot be de-

pended upon in all cases, especially in twins, transverse presentation and hydramnios. When the greatest thickness of the placenta is noted in the superior fundus, it may be safely said that the cause of the patient's bleeding is not placenta previa. When the greatest thickness of the placenta is located on the lateral wall, further study is necessary. Buxton, Hunt and Potter[6] are of the opinion that the lower uterine segment and the internal os may be covered when the mass of the placenta is seen below the equator of the uterus. Only a fair reliability can be credited to this in our series. Of 27 cases found to lie below the equator, 14 were found to be placenta previa or low implantation, while 4 cases noted to be above the equator were known to have a low implantation. A point of greater importance in the examination of the roentgenograms with a possible low implanted placenta is the measurement of the distance between the fetal head and the sacral promontory and between the fetal head and the symphysis pubis. This was first suggested by Brown and Dippel.[4] It requires, of course, a vertex presentation with a normal size fetus and has its maximum value just before the onset of labor, when the head is beginning to engage. In the cases with posterior implantation, but negative for placenta previa, the distance between the sacral promontory and the fetal head averaged 1.7 cm. In those cases proved to be low implanted or marginal placenta previa, the average distance was 3.4 cm. A similar study of the fetal head to symphysis distance with an anterior implantation of the placenta shows that the negative cases averaged 3.0 cm., while those with low implantation and marginal placenta previa averaged 4.9 cm. These values are registered for a 36 inch target-film distance. Consequently, it will be seen that these measurements are of great value in diagnosing a questionable case; this is particularly true for the posterior implanted placenta. It should be a rule that these anatomical landmarks be included in the lateral soft tissue roentgenograms.

In our experience, regardless of the position or presentation of the fetus, it is possible to diagnose the great majority of cases at any time during the last trimester of pregnancy with the two film, soft tissue roentgenographic technique. In any case in which the placenta cannot be visualized in the upper uterine segment, it must be, ipso facto, in the lower uterine segment and is reported as placenta previa. For that group of cases in which the findings are doubtful, a pneumocystographic study is carried out. The value of the use of air in the bladder has been shown by Snow.[27] He found it to be: (1) cheaper than radiopaque media; (2) non-irritating; (3) less dense than the tissues and therefore offering more contrast, as a radiopaque medium will obscure the tissues. The bladder is injected with approximately 200–250 cc. of air. It is important that the bladder be well distended by the air. A partially filled bladder makes interpretation more difficult. At this time, two 11×14 inch films, in the anteroposterior and lateral projection, are taken, centering over the bladder. This is done to prevent distortion of the vesicocephalic measurements. In the cases negative for low implantation or placenta previa, this measurement averages 1.2 cm.; in the positive cases the average measurement is 2 cm. This measurement is best made in the lateral projection. A sign of additional importance is a displacement of the bladder to one side or the other. This occurs when the placenta is implanted on the lateral uterine wall and extends into the lower uterine segment. It is a valuable sign, best seen in the anteroposterior projection. The value of pneumocystography is limited to anterior and lateral implantations of the placenta. A normal appearance may be obtained when the placenta occupies the posterior wall of the uterus and covers the internal os (Jarcho[18]). In these cases a widening of the sacral promontory-fetal head distance should be sought. Another sign of value, associated with this, is a displacement of the fetal head from the mid-coronal and sagittal planes, suggested by Ball and

Golden.[2] This technique calls for films taken in the erect position. As a diagnostic sign, they found it to be extremely accurate. As none of our cases were examined in this manner, we are unable to apply this test to our series.

SUMMARY

1. A group of 132 patients with the presenting symptom of bleeding during the last trimester of pregnancy was examined in the Department of Radiology for the presence of placenta previa.

2. The accuracy of this method of examination was 87.8 per cent with the best results in the group diagnosed as negative for placenta previa—97 per cent.

3. The roentgen examination for placenta previa has proved to be a valuable adjunct to the sterile pelvic examination. The two examinations are somewhat complementary. The former enables the obstetrician to treat bleeding cases with greater exactitude.

4. A soft tissue roentgenographic study of the abdomen is first made. If, after careful study, the main portion of the placenta is found to lie in the fundus, it is reported as negative for placenta previa and no further examination is made. If the placenta is not visualized in this position, an air cystogram is done to determine if there is any tissue intervening between the fetal head and the bladder wall.

5. The following signs are of value in positive diagnosis of placenta previa: (*a*) failure to visualize the placenta in the body of the uterus—suggests central placenta previa; (*b*) location of mass of placenta below the equator of the uterus; (*c*) widening of sacral promontory-fetal head distance when the placenta is implanted upon the anterior wall; (*d*) widening of symphysis pubis-fetal head distance when the placenta is implanted upon the anterior wall; (*e*) widening of the vesicocephalic distance seen after pneumocystography; (*f*) lateral displacement of the bladder seen after pneumocystography; (*g*) displacement of the fetal head from the mid-coronal and sagittal planes.

REFERENCES

1. Arnell, R. E., and Guerriero, W. F. Management of placenta previa, with analysis of 260 consecutive cases. *Am. J. Obst. & Gynec.*, 1940, *39*, 32–38.
2. Ball, R. P., and Golden, R. Roentgenologic sign for the detection of placenta previa. *Am. J. Obst. & Gynec.*, 1941, *42*, 530–533.
3. Beck, A. C., and Light, F. P. X-ray diagnosis of placenta previa. *Am. J. Obst. & Gynec.*, 1938, *35*, 1028–1031.
4. Brown, W. H., and Dippel, A. L. Uses and limitations of soft tissue roentgenography in placenta praevia and certain other obstetrical conditions. *Bull. Johns Hopkins Hosp.*, 1940, *66*, 90–105.
5. Burke, F. J. Amniography. *J. Obst. & Gynaec. Brit. Emp.*, 1935, *42*, 1096–1106.
6. Buxton, B. H., Hunt, R. R., and Potter, C. X-ray localization of placenta. *Am. J. Obst. & Gynec.*, 1942, *43*, 610–619.
7. Campbell, A. M., Miller, J. D., Menees, T. O., and Holly, L. E. Diagnostic value of radiopaque contrast media in gynecology and obstetrics. *Am. J. Obst. & Gynec.*, 1932, *24*, 542–552.
8. Carty, J. R. Soft tissue roentgenography. Am. J. Roentgenol. & Rad. Therapy, 1936, *35*, 474–484.
9. Carvalho, M. A. Study of 111 cystograms for diagnosis of placenta previa. *Am. J. Obst. & Gynec.*, 1940, *39*, 306–312.
10. Cornell, E. L., and Case, J. T. Neoskiodan in amniography. *Am. J. Obst. & Gynec.*, 1934, *27*, 894–896.
11. Dippel, A. L., and Brown, W. H. Direct visualization of placenta by soft-tissue roentgenography. *New England J. Med.*, 1940, *223*, 316–323.
12. Dippel, A. L., and Brown, W. H. Roentgen visualization of placenta by soft tissue technique. *Am. J. Obst. & Gynec.*, 1940, *40*, 986–994.
13. Ehrhardt, K. Die röntgenologische Darstellung der Placenta im Tierexperiment. *Klin. Wchnschr.*, 1932, *11*, 332–333.
14. Friedman, J., and Macdonald, D. O. Roentgen ray diagnosis of placenta praevia. *Canad. M. Ass. J.*, 1935, *32*, 12–14.
15. Hall, S. C., Currin, F. W., and Lynch, J. F. Diagnostic value of x-ray in placenta previa. *Am. J. Obst. & Gynec.*, 1937, *33*, 625–631.
16. Hewitt. Cited by Kerr and Mackay.[19]
17. Holmes, N. H. Use of x-ray in placenta previa. *Rev. Med. Progress*, 1941, 23–24.

18. Jarcho, J. Placenta previa; roentgen diagnosis, treatment, and technique for induction of premature labor. *Am. J. Surg.*, 1940, *48*, 485–522.
19. Kerr, J. M. M., and Mackay, W. G. Diagnosis of placenta praevia, with special reference to employment of x-rays for this purpose. *Tr. Edinburgh Obst. Soc.*, pp. 21–32, 1932–1933; in *Edinburgh M. J.*, March, 1933.
20. McDowell, J. F. Cystographic diagnosis of placenta previa. *Am. J. Obst. & Gynec.*, 1937, *33*, 436–443.
21. McIver, J. Use of cystogram in diagnosing placenta praevia. *Texas State J. Med.*, 1936, *32*, 471–474.
22. Menees, T. O., Miller, J. D., and Holly, L. E. Amniography; preliminary report. Am. J. Roentgenol. & Rad. Therapy, 1930, *24*, 363–366.
23. Prentiss, R. J., and Tucker, W. W. Cystography in diagnosis of placenta previa. *Am. J. Obst. & Gynec.*, 1939, *37*, 777–787.
24. Priest, R. E. X-ray diagnosis of placenta previa in general practice. *Minnesota Med.*, 1937, *20*, 163–167.
25. Snow, W., and Powell, C. B. Roentgen visualization of placenta. Am. J. Roentgenol. & Rad. Therapy, 1934, *31*, 37–40.
26. Snow, W., and Rosensohn, M. Roentgenologic visualization of soft tissues in pregnancy. Am. J. Roentgenol. & Rad. Therapy, 1939, *42*, 709–717.
27. Snow, W. Clinical Roentgenology of Pregnancy. Charles C Thomas, Springfield, Illinois, 1942. Chapter 6.
28. Stander, H. J. In: Williams, J. W. Obstetrics. Appleton Century Co., New York, pp. 1108–1119.
29. Torpin, R. Study of placental site and intrauterine relations by original method of amniotic sac distension; report of 144 cases. *J. Obst. & Gynaec. Brit. Emp.*, 1938, *45*, 993–998.
30. Ude, W. H., and Urner, J. A. Roentgenologic diagnosis of placenta previa. *Am. J. Obst. & Gynec.*, 1935, *29*, 667–669.
31. Ude, W. H., Weum, T. W., and Urner, J. A. Roentgenologic diagnosis of placenta previa. Am. J. Roentgenol. & Rad. Therapy, 1934, *31*, 230–233.
32. Ude, W. H., Urner, J. A., and Robbins, O. F. Roentgenologic diagnosis of placenta previa; indirect placentography. Am. J. Roentgenol. & Rad. Therapy, 1938, *40*, 37–42.
33. Vaughan, C. E., Weaver, R. T., and Adamson, D. L. Roentgenographic visualization of placenta, utilizing plastic filter. *Canad. Med. Ass. J.*, 1942, *46*, 314–321.
34. Weintraub, S., and Snow, W. Roentgenologic visualization of soft structures of pregnancy; experimental evidence. Am. J. Roentgenol. & Rad. Therapy, 1939, *42*, 718–720.
35. Weyl, C., Warren, S. R., Jr., and O'Neill, D. B. Radiologic Physics. Charles C Thomas, Springfield, Illinois, 1941. Chapter 14. Effect of variations of exposure factors on roentgenographic results.

NON-SECRETING CYSTS OF THE MAXILLARY SINUSES

WITH SPECIAL REFERENCE TO THE ROENTGEN ASPECTS AND DIAGNOSIS OF THE LARGE TYPES

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THE maxillary sinus is a frequent site for benign cysts of various types. It is the purpose of this paper to discuss the lack of diagnostic clinical signs and symptoms and the importance of the roentgenogram in the diagnosis of the most common type of cyst of the antrum, the so-called non-secreting or mesothelial cyst, with special reference to those which are large and fill the entire antrum.

The recent literature[1,2,3,4] presents interesting studies of benign cysts of the maxillary sinus. A simple classification of these cysts as offered by Lindsay[2] is:

1. Benign cysts arising from the jaw or teeth
   a. Follicular (dentigerous) cyst
   b. Radicular (root cyst, dental cyst)
   c. Median anterior maxillary cyst
2. Benign cysts arising from the sinus mucosa
   a. Secreting cysts
      Gland or mucous cysts
      Mucocele
   b. Non-secreting cysts of sinus mucosa (Lindsay) (mesothelial cysts of McGregor[4])

As stated before, non-secreting cysts are by far the most common type of cyst found in the antrum, and only these will be discussed in detail. They arise in the subepithelial connective tissue of the sinus mucosa due to a retention of fluid in the connective tissue spaces. The cause for the retention of fluid is probably the action of bacterial toxins resulting from infection, producing damage of the capillary walls and altering their permeability. The equilibrium of the water balancing mechanisms of the tissues is thus upset.

The rôle of allergy in this process is still in doubt. The increase of fluid in the connective tissue spaces compresses the connective tissue septa, causing them to break down and thereby allowing individual collections of fluid to coalesce and form cysts. These cysts are not lined by epithelium. On histological examination they appear to have a definite wall. This, however, is formed by connective tissue, and consists of one or more layers of elongated compressed connective tissue cells.

The cysts may vary in size from minute ones, just forming, to those which fill the entire antrum. The length of time it takes for the large cysts to form is unknown. It may vary from months to years. We have observed 3 cases of probable non-secreting cysts, of moderate size (filling approximately one-third of the antrum) with no appreciable change in size over a period of three months.

Even though the cyst wall is very thin the cysts may reach a large size due to the supporting action of the antral walls and floor. It is believed[2] that regardless of their point of origin in the sinus mucosa, the cysts eventually gravitate downward to the most dependent portion of the antrum. When they become large they may prolapse through the ostium of the sinus and then rupture spontaneously. In none of our cases of large cysts did we find any prolapse.

These cysts are said to be found only in the antrum. They are most apt to occur in an edematous soft lining membrane. They contain a thin, clear, amber or straw-colored fluid which coagulates quickly after being removed from the sinus. Lindsay, by chemical analysis, has shown that the fluid in these cysts must be classified as an exudate. The fluid is usually sterile by ordinary culture methods. Occasionally a cyst may become infected, thereby forming a pyocele.

CLINICAL ASPECTS

Frequency. In a series of 80 consecutive roentgen examinations of the sinuses, 13 cases of probable cysts of the antrum were found. Six of these were large non-secreting cysts filling the entire antrum (as far as could be judged by roentgenograms made in the Waters position, without the use of contrast medium). In 1 case there were large cysts in each antrum. Two of the other cases of large cysts had a small cyst in the opposite antrum. Our series indicates that the bilateral occurrence of these cysts is not unusual.

Cysts were the most common lesion observed in this particular group of cases, although the examinations were made in the winter when acute infections of the sinus are frequent. However, it is also true that the examinations were conducted at a time when allergic manifestations are infrequent. All the cases found were in young adult males, twenty-one to twenty-nine years of age.

Symptoms. The symptoms of this type of cyst cannot be relied upon for clinical diagnosis. They are too obscure and variable to set a definite criterion for identification. In our series of 6 cases of large cysts of the antrum the following symptoms were observed: In 3 instances the predominating symptom was *toothache* referred to the upper teeth on the side of the cyst. In 2 cases, a first upper molar was extracted with no relief of the pain. In another case the symptoms of toothache were of such intensity that morphine sulfate was given, with no relief. In this case a tooth extrac-

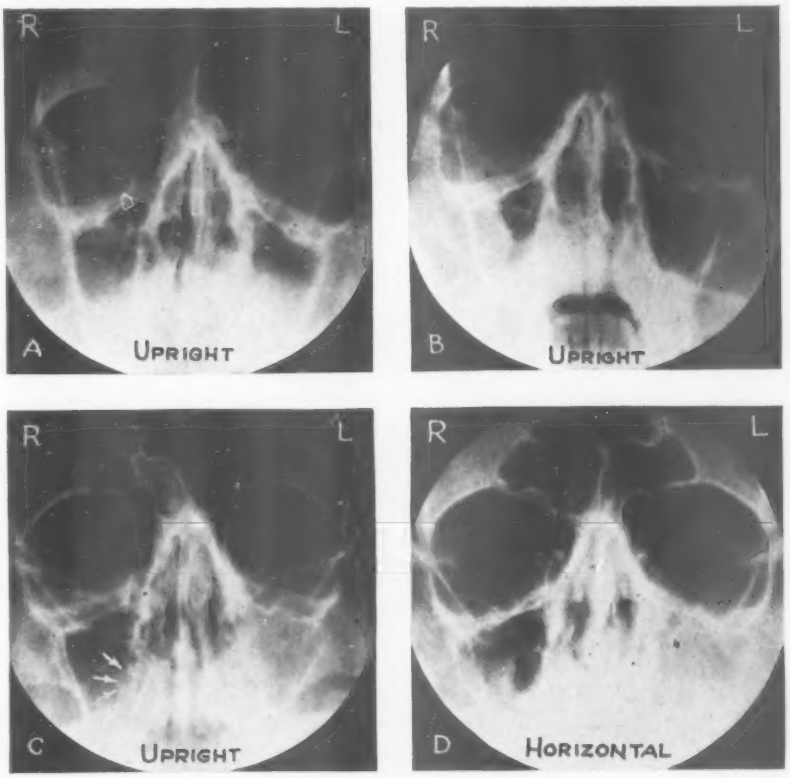

FIG. 1. *A*, typical dome-shaped cyst arising from the floor of the left antrum. *B*, cyst arising from the lateral wall of the right antrum. *C*, large non-secreting cyst filling the left antrum, and a small cyst (arrows) arising from the medial wall of the right antrum. *D*, large non-secreting cyst filling the left antrum.

tion was not done because on examination the teeth were normal. Still another case complained of numbness of the upper teeth. It is probable that in these 4 patients the cysts had completely filled the antrum and were under pressure.

Other symptoms complained of were frequent colds, sore throats, and general malaise. In the 2 cases of large cysts where there were no symptoms referable to the teeth, the patients complained of slight pain in the sinus region, but only after direct questioning. In these cases the cysts were probably not under pressure,although they appeared on the roentgenogram to fill the entire antrum. Lindsay, in discussing the symptoms of his cases of both large and small cysts, believes that these cysts are capable of producing a variety of symptoms, which include . . . "fatigue, irritability, headaches, low grade fever, mild dizziness, pains in the joints. Local symptoms of sinus disease may be present or absent. This type of cyst may constitute a focus in infectious arthritis." McGregor is also of the opinion that these cysts may act as foci of infection. There were no instances of symptoms referable to the teeth in Lindsay's series, although several of the cysts in the cases he reported produced an opacity of the entire antrum.

In none of our cases was there a spontaneous rupture of the cyst with a sudden gush of the typical straw-colored, clear fluid from the nose as does occasionally happen, especially during coughing or sneezing.[2]

Clinical Examination. The examination of our patients by nasal speculum was essentially negative. The mucous membrane was of a normal pink color and no pus was noted before or after shrinkage of the membrane. No tenderness to palpation over the involved sinus was elicited, even in those patients with toothache. This is unlike the toothache which may accompany inflammatory disease of the sinus in which there is usually tenderness of the antrum on palpation. The throats appeared normal although 2 patients complained of sore throat at the time of the examinations. The involved sinuses transilluminated well in all cases. The scarcity or absence of local findings referable to the sinuses is one of the important features of this lesion.

Results of Antral Puncture in the Large Type of Cyst. Puncture of the antrum through the inferior meatus produced an immediate spontaneous return of the characteristic cystic fluid when the stylet of the puncture needle was withdrawn. In those cases with intense toothache, there was an immediate cessation of pain after a few cubic centimeters of fluid was allowed to drop out through the needle. The amount of fluid removed varied from 4 to 10 cc. Drainage through the needle stopped spontaneously, probably due to its position. Clotting of the fluid in the needle was minimized by frequently inserting the stylet. None of the cysts was completely drained through the needle, as revealed by post-puncture roentgen studies. In all, the typical straw- or amber-colored, clear fluid was obtained. In all 6 instances the liquid coagulated quickly after removal.

ROENTGEN ASPECTS

Importance of Roentgen Examination. The roentgenogram is the most important factor in the diagnosis of non-secreting cysts of the antrum, both large and small. This is true because symptoms, signs and findings referable to the sinus may be absent, even in large cysts. Sinuses containing these cysts transilluminate well. This is important since some rely on transillumination. (in conjunction with the clinical findings) for a diagnosis of sinus disease to the exclusion of the roentgen examination. In addition to the above findings, it should be recorded that symptoms of large cysts under pressure may be misleading, since the predominating symptom of pain may be referred to the teeth. Small and even moderate sized cysts may be missed by diagnostic puncture of the antrum. This has been true in our experience and in the experience of others. This is explained on

purely anatomical grounds, the cyst being either too small, or situated in such a position that it cannot be reached. It is here that lipiodol studies may be of value in accurately localizing the cyst so that special techniques of puncture may be used to reach them (Fig. 2). In case of a "dry tap" in instances of cysts missed by puncture, returns of the irrigating fluid may be clear (unless there is infection present in the remainder of the sinus).

Therefore, unless roentgen studies are carried out, an erroneous diagnosis of a normal sinus may be made, due to the absence or scarcity of symptoms and signs of sinus disease, and the possibility of a negative puncture in cases with small and medium sized cysts.

Technique. The roentgenogram of most importance in the diagnosis is that made in the Waters position. All sinus roentgenograms are routinely made with the patient in the upright position. If any pathologic appearance is noted on this roentgenogram, a similar view is taken with the patient in the horizontal position. The chief value of this latter view is to show movement of free fluid.

Findings. The cysts may arise from any wall, but they are most often seen arising from the floor of the sinus. Small and moderate sized cysts usually appear as sharply defined, dome-shaped masses projecting into the sinus and are well visualized in contrast to the air in the remainder of the antrum (Fig. 1, *A*, *B* and *C*). These types are easy to recognize roentgeno-

FIG. 2. Lateral view of right antrum following injection of opaque oil (see Fig. 1*B* for Waters' position of same case). Antral puncture was performed twice without success. The opaque oil injection revealed the anterior location of the cyst (arrows). In such cases a curved trocar and needle are necessary to reach the cyst. This case illustrates that a negative antral puncture and a clear return of irrigating fluid does not rule out antral disease.

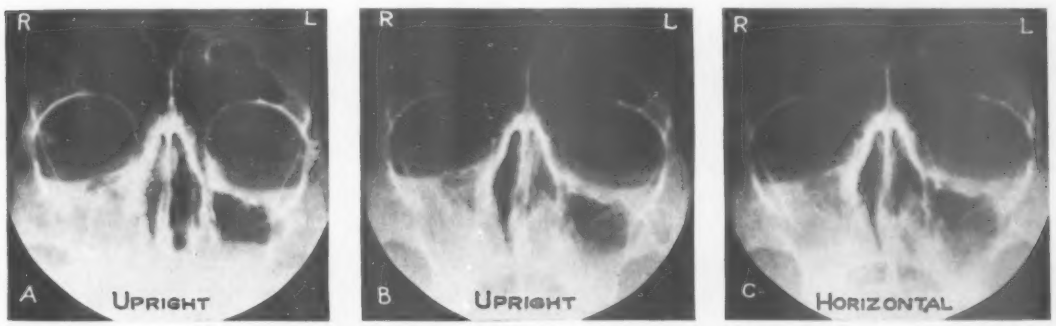

FIG. 3. *A*, large non-secreting cyst filling the right antrum. Density in the inferior portion of the left antrum with a sharp margin simulating a fluid level. This appearance did not change on a roentgenogram made in the horizontal position, ruling out free fluid. This density represents a small cyst. *B* and *C* were made following puncture of the right antrum. The cyst of the right antrum did not change in appearance in spite of the puncture and drainage (spontaneous through the puncture wound) over a two month period of observation. The cyst in the left antrum increased slightly in size. In *B* its upper margin simulates a fluid line. The roentgenogram made in the horizontal position rules out free fluid and in addition shows a dome-shaped upper border, further substantiating the diagnosis of a cyst.

logically. They are most apt to be confused with solitary polyps. Polyps, however, are apt to occur in individuals with allergic manifestations, and the lining membrane of the sinus in these cases usually shows a generalized thickening. This is not true in sinuses containing cysts, although occasionally one portion of the lining membrane may appear thickened, due probably to an accumulation of cystic fluid which has not united with the main cyst.

Occasionally a cyst in the floor of the sinus. This finding is mentioned by McGregor, Lindsay, and Hardy. Judging from their experience and from ours, these cysts are a common cause of an opaque sinus on the roentgenogram (Fig. 1, *C* and *D*, Fig. 3, 4 and 5). The following are the characteristic roentgen findings produced by these large cysts:

1. *An increase in density of the entire antrum.* The density is usually uniform. In the Waters position, ethmoid cells are frequently seen in the superior and medial

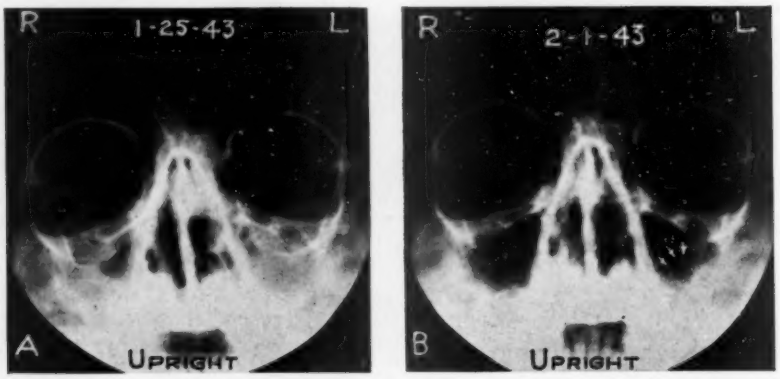

Fig. 4. *A*, large non-secreting cyst filling the left antrum. Hyperplastic sinusitis of the right antrum. *B*, roentgenogram made following puncture showing the collapsed cyst in the inferior portion of the antrum (arrows). A roentgenogram made March 3, 1943, showed a normal sinus.

antrum may simulate a fluid level when the roentgenogram is made in the upright position. This is not uncommon since we have observed 2 such cases. Pancoast, Pendergrass and Schaeffer[5] illustrate a similar case. Two of Lindsay's cases presented this appearance, one being reported as a fluid level, and the other being reported as resembling a fluid line. One of Hardy's[1] cases was similar in appearance. It is here that the roentgenogram made in the horizontal position is of greatest value. Free fluid would change its position and cause a clouding of the entire sinus. Fluid in a cyst remains localized and may, due to pressure changes and slight changes in angle of exposure, become characteristically dome chaped (Fig. 3).

As the cysts grow, they become large enough to produce an opacity of the entire aspect of the antrum. These may either be ethmomaxillary cells or posterior ethmoid cells or both. In addition, a part of the superior orbital fissure and the infra-orbital foramen may be projected into the superior portion of the antrum. These cells, the fissure and the foramen, due to their radiolucent appearance, produce some irregularity in the superior and medial portion of the density produced by the cyst. Here it would be well to mention that it is also possible for membranous or osseous septa to form separate compartments in the sinus, so that a cyst could fill one compartment only. We have not encountered such a case.

2. *No change in the appearance of the density in upright and horizontal views.* This is important in those instances where roentgenograms are routinely taken in the horizontal position. It is essential that roent-

genograms be taken in the upright position to rule out free fluid in the sinus (Fig. 6).

3. *No change in osseous wall of the sinus to indicate either infection, pressure atrophy, or bone destruction due to invasion.* This is explained by the lack of active inflammation (the fluid is usually sterile by ordinary culture methods), the benign character of the cysts, and their structure, that is, their thin lining and their tendency to prolapse through the ostium when they become large, and to rupture spontaneously rather than to produce pressure atrophy.

It is possible from these roentgen findings alone to suspect the presence of these cysts. The knowledge that local signs and symptoms of sinus disease are few or absent, and that the sinuses transilluminate well, enables one to make the diagnosis. At some time in the development of these cysts there must be a stage between the typical dome-shaped cyst and the large cyst filling the entire sinus, in which the cyst will fill most of, but not all of the antrum. We have not encountered such a case. However, in the presence of an opacity of the major part of the antrum, which does not alter its shape in upright and horizontal views, and in which the sinus wall shows no changes, a cyst should be considered. Furthermore, if the clinical signs and symptoms of sinus disease are few or absent, and the sinus transilluminates well, the diagnosis of a cyst is justified.

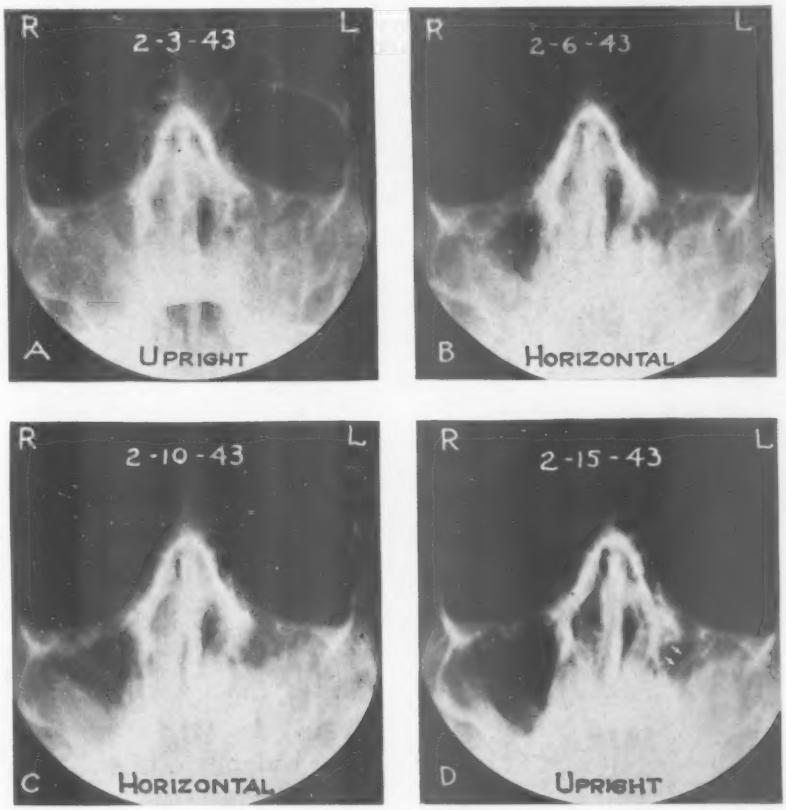

FIG. 5. *A*, large non-secreting cysts of both antra. Each antrum was punctured. The cyst on the right side collapsed rapidly in the twelve days following the puncture during which time cyst fluid drained through nose. *B*, *C*, and *D*. Note the resemblance of the partially collapsed cyst (*B*) to a thickening of the lining membrane of the sinus. Although cyst fluid drained from the left side during this period the cyst did not collapse readily. In *D* collapse has occurred to a sufficient degree so that the top of the cyst is visible (arrows).

Roentgen Studies Following Puncture of Large Cysts. In 1 case, one week following the puncture, during which time cystic fluid drained through the nose, the cyst was collapsed and appeared as a small nodule in the floor of the sinus, with the typical dome-shaped appearance of small cysts. Four weeks later the antrum appeared normal (Fig. 4).

In another case, following puncture cystic fluid drained in small amounts through the nose, but the cyst did not collapse, and its appearance on the roentgenogram remained unchanged (Fig. 3).

In the patient with the bilateral cysts, puncture was performed on both sides, Drainage through the nose followed thereafter. On one side the cyst collapsed rapidly. At one stage in this process of regression, the findings on the roentgenogram simulated a thickening of the mucoperiosteal lining of the sinus. The cyst on the other side collapsed very slowly. This was only evident roentgenologically after the cyst on the opposite side was almost completely collapsed (Fig. 5).

Differential Diagnosis. The large, nonsecreting cyst which produces an opacity of the entire antrum must be differentiated from all other lesions producing a similar roentgen appearance. These include:

1. Inflammatory lesions
2. Cysts of dental origin
3. Mucous cysts and mucoceles
4. Polypi
5. Tumors (especially carcinoma) and granulomata.

In all of these conditions, the sinus transilluminates poorly. In brief, the following are the most important additional points in the differential diagnosis:

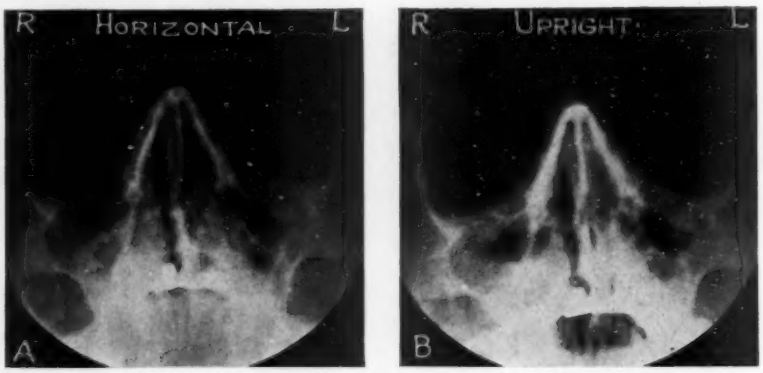

Fig. 6. *A*, roentgenogram made in the horizontal position shows a diffuse opacity of the right antrum. In this respect a cyst is simulated. However the roentgenogram made with the patient in the upright position, *B*, shows a fluid level, with a thickened lining membrane. This was an inflammatory lesion, with clinical signs and symptoms of acute sinusitis. The sinus did not transilluminate.

1. In acute inflammatory disease of the antrum the opacity seen in the roentgenogram is due to the thickening of the lining membrane of the sinus, or fluid, or both. Roentgenologically, fluid may be demonstrable by roentgenograms made in different positions. These also show the thickening of the mucoperiosteal lining of the sinus, either alone or in combination with fluid. The hyperplasia of the membrane may not be visible on the horizontal view when there is fluid present. The upright view which results in a shift of the fluid to the most dependent portion of the sinus will reveal this thickened membrane (Fig. 6). The clinical signs and symptoms of acute sinus disease are quite apparent. The hazy appearance of the sinus wall, seen in

acute inflammatory processes of the antrum, may also be detected (Fig. 7). Inflammatory lesions are the ones which have to be differentiated most often.

2. In cysts of dental origin, the relationship to the teeth should be demonstrable by careful roentgen studies, and changes in the floor of the sinus may be detected.

3. Mucoceles are rare in the antrum. We have never observed one, but in mucoceles large enough to produce an opacity of the antrum, pressure or invasion changes are usually present in the wall of the sinus. At this stage, too, they are apt to produce external deformity of the face, and marked pain in the sinus.

4. Carcinoma of the antrum, which is the most common malignant tumor encountered, is apt to have caused bone destruction, invasion of adjacent soft tissue, and may produce severe pain by the time the roentgenogram shows a diffuse opacity of the antrum.

5. Polypi are most apt to occur in individuals with allergic manifestations. In those instances where the entire antrum is opaque due to polyps, there are apt to be polypi in the nose, easily detected by nasal examination.

SUMMARY AND CONCLUSIONS

1. In a consecutive series of eighty roentgenograms of the sinuses for a suspected pathologic condition, thirteen instances of probable cysts of the antrum were found. Six of these produced an opacity of the entire antrum. These were found to be non-secreting or mesothelial cysts. In our experience, non-secreting cysts are the most common type of cyst occurring in the antrum.

2. Local signs and symptoms of sinus disease may be absent or meager even in large cysts of this type. The sinuses transilluminate well. Small and medium sized cysts may be entirely missed by antral puncture. Antral irrigation in such instances is usually also negative. Therefore the roentgenogram is the only way to detect their presence.

3. Large cysts under pressure may give rise to severe toothache as the predominant symptom. In these instances there is no tenderness over the involved antrum, such as is often present in inflammatory lesions of the sinus giving rise to toothache.

4. When the cysts become large they produce an opacity of the entire antrum on the roentgenogram. This opacity remains

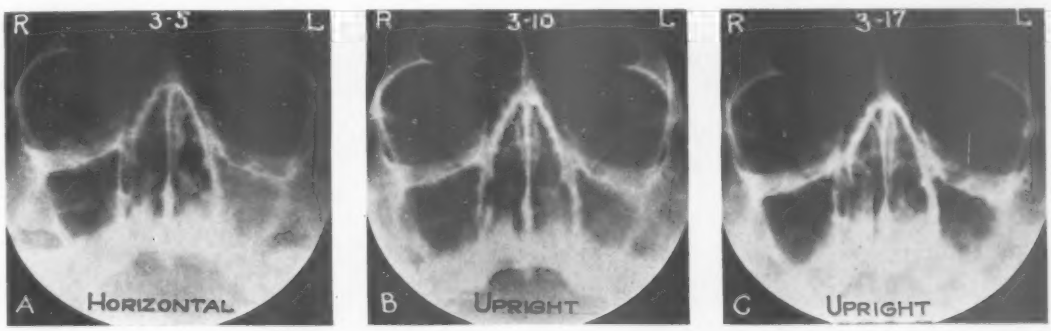

FIG. 7. *A*, opacity of the left antrum with no change in its appearance in the upright and horizontal position. (Only the horizontal view is shown.) In this respect a cyst is simulated. However, the sinus wall shows the hazy appearance of an acute infection, and clinically the signs and symptoms of an acute sinusitis were present. The sinus did not transilluminate. The opacity in this instance was due to an acute inflammatory lesion with thickened membrane and pus. Local treatment resulted in rapid improvement. *B* and *C*. In *B*, the appearance is due to an irregularly thickened membrane. Note the inequality of size of the maxillary sinuses an anomaly of development.

constant in appearance on roentgenograms made in the horizontal and upright positions. There are no changes in the sinus wall to indicate either infection, pressure atrophy, or invasion.

5. In the presence of an opaque antrum, with the characteristics given, a large nonsecreting cyst should be considered. Knowing the clinical findings and with the knowledge that the sinus transilluminates well, the diagnosis can be made with reasonable certainty.

REFERENCES

1. Hardy, G. Benign cysts of antrum. *Ann. Otol., Rhin. & Laryng.*, 1939, *48*, 649–657.
2. Lindsay, J. R. Nonsecreting cysts of maxillary sinus mucosa. *Laryngoscope*, 1942, *52*, 84–100.
3. Love, A. A. Dentigerous cysts of antrum. *Arch. Otolaryng.*, 1934, *19*, 348–366.
4. McGregor, G. W. Formation and histologic structure of cysts of maxillary sinus. *Arch. Otolaryng.*, 1928, *5*, 505–519.
5. Pancoast, H. K., Pendergrass, E. P., and Schaeffer, J. P. The Head and Neck in Roentgen Diagnosis. Charles C Thomas, Springfield, Illinois, 1940.

POSTOPERATIVE EMPHYSEMATOUS BULLAE FOLLOWING LUNG ABCESS*

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PATHOLOGICAL conditions following surgical treatment of lung abscess have not been the subject of much roentgenographic investigation. Farrell[2] made a rather comprehensive study of postoperative changes in 23 cases of lung abscess, describing the appearance of ribs, pleura, lung and diaphgram. He found the usual uncomplicated course, roentgenographically, was peripheral clearing of the dense shadowing in the lung terminating in either a clear lung or more or less fibrosis, depending on the site and size of the abscess and the amount of surrounding pulmonary involvement. No mention is made of the finding of emphysematous bullae or pneumatocele. Boch[1] reported a case of emphysema and bronchiectasis in which there had been a history of the patient recovering from a lung abscess. At autopsy, there was a cavity whose trabeculated walls contained connective tissue. The interior space was lined with smooth, glistening membrane of epithelium similar to that in a bronchiole. It is not clear from the information given whether this was a pneumatocele or an epithelized, residual lung abscess. Franklin[4] described 6 cases studied by means of broncography, illustrating various types of residual defects in the lung and bronchi, classifying them as cavitary and bronchiectatic. In the case here reported, another type of defect following surgical treatment is described.

CASE REPORT

A. S., Mexican female, aged fifteen. Present illness dates from October, 1938, when tonsillectomy was performed under a general anesthetic. Several days later, the patient became ill with severe cough and expectoration of foul, purulent sputum. The temperature was 103° F. In December, 1938, she had a hemoptysis and was sent to the Los Angeles General Hospital. The sputum was reported as positive for acid-fast bacilli and she was referred to the Olive View Sanatorium with a diagnosis of moderately advanced pulmonary tuberculosis (Fig. 1). The temperature range at this time was 99.6 to 100.0° F., pulse 80 to 130, respiration 20 to 26, sputum 2 to 6 ounces daily, purulent and with a very foul odor. On two different occasions in January, 1939, acid-fact bacilli were found on concentration. Unfortunately, there were no cultures or guinea pig inoculations. Bronchoscopy, on January 24, 1939, showed pus welling from the right upper lobe bronchus. The roentgen examination at this time (Fig. 2 and 3) showed an increase in dense, confluent involvement through most of the right lung with several fluid levels due to cavity or abscess formation.

FIG. 1. Dense, confluent involvement in middle part of right lung with fluid level.

Despite the finding of acid-fast bacilli in the sputum, it was considered that the patient had a lung abscess and operation was performed on

* Presented before the Trudeau Society of Los Angeles in May, 1943.

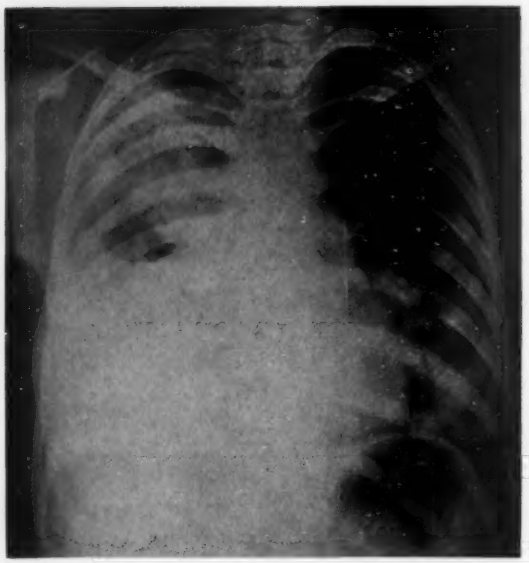

Fig. 2. Marked increase in involvement with multiple fluid levels, eleven days after first roentgenogram.

February 1, 1939, with resection of portions of the third and fourth ribs anteriorly. Three abscesses were opened with cautery and drained. Both the pus evacuated from the abscess and a section of the abscess wall were negative for tuberculosis, both by culture and guinea pig inoculation. The pus showed many gram-negative pleomorphic motile bacilli.

The postoperative course was uneventful; cough lessened immediately and expectoration dwindled steadily, ceasing in six weeks. Clinical improvement continued until her discharge, in December, 1939, at which time she was free from all symptoms and in a better state of nutrition than she had ever previously experienced.

Fig. 3. Lateral view showing location of abscesses in right lung.

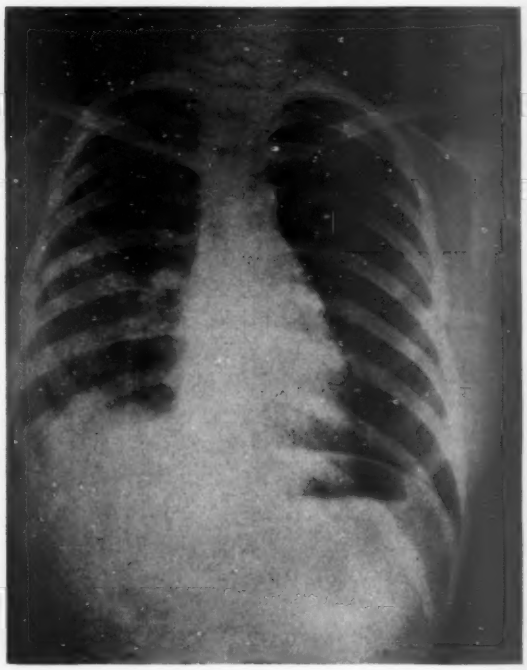

Fig. 4. Conventional roentgenogram nine and a half months after drainage of abscesses. There is slight thickened pleura over the right lung with a few clear-cut linear shadows.

A conventional roentgenogram in November, 1939 (Fig. 4) showed considerable thickened pleura over the site of operation and a number of very fine, thin, interlacing, white lines through the region where the abscesses had been located. Because the nature of these shadows could not be determined adequately in the stereoscopic view, the patient was examined by means of the rectilinear planigraph. The planigrams of the anterior half of the right lung (Fig. 5) showed several high-lighted areas, near the

lateral chest wall, bounded by very thin, almost hair-like white lines, with no lung markings within them. These were rather irregular in shape and of variable size. Lateral planigrams (Fig. 6) through this region showed them even more distinctly and in this projection they were more rounded.

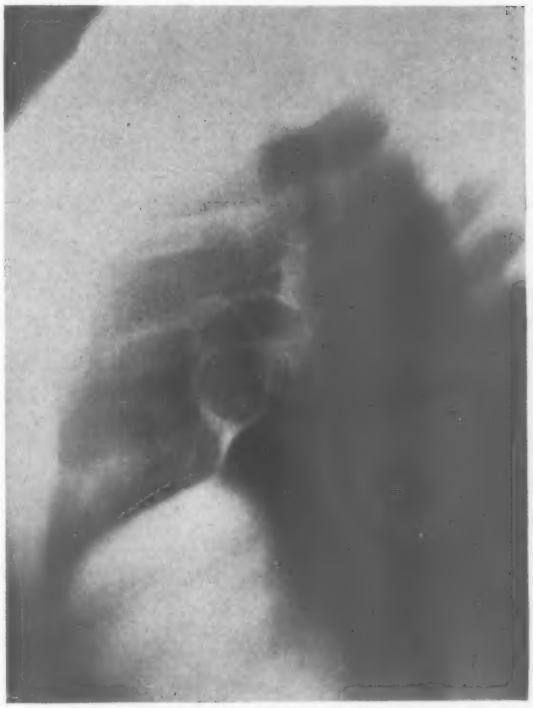

Fig. 6. Lateral planigram of same area, showing emphysematous bullae.

COMMENT

This case was something of a diagnostic problem because of the finding of acid-fast bacilli in the sputum on three different occasions in two different institutions. However, in retrospect, it hardly seems possible that the abscess cavities present in the lung were due to tuberculosis, because of the very prompt result of open drainage which is not the experience encountered in treating tuberculous cavities by this method. Since no cultures or animal inoculations were made preoperatively and the pus evacuated at operation was negative by culture and guinea pig inoculation, it must be concluded that the acid-fast bacilli were some non-pathogenic organism rather than tubercle bacilli.

Fig. 5. Planigram of right lung showing several emphysematous bullae at former site of lung abscess.

The shadows observed in the planigrams are not of the type characteristic of tuberculous cavities, bronchiectatic dilatations or residual abscesses. The outlining walls are very thin, uniform in thickness and there is no increase in density of the surrounding parenchymal structure. The appearance is the same as in patients with emphysematous bullae, as described by Freedman,[5] Hayashi,[6] Jäderholm,[7] Laurell,[8] and others. Peirce and Dirkse[9] described 4 cases in which pneumonia was followed by the development of what they termed "pulmonary pneumatocele (localized alveolar or lobular ectasia)." The appearance of these lesions is essentially the same as in the case described above except for size and number. They feel, as does Fischer-Wasels,[3] that inflammatory changes result in a

check-valve mechanism with the production of progressive distal expansion of distal alveoli. Hayashi found evidence of a valve-like structure at the base of such vesicles. In this case, there was surgical interference in this immediate area and the formation of bullae could presumably result from either process or both.

If seen for the first time, without the history which this case presented, these bullae might fall into a considerable class of cases probably very largely misdiagnosed congenital cystic disease. The first roentgenograms made on this patient showed nothing even suggestive of pneumatocele.

As Peirce and Dirkse have shown, pneumatoceles may completely disappear and even if they do not, there seems to be no unfavorable clinical prognosis. Routine investigation of cases of healed lung abscess by body section roentgenography, especially among those who have received surgical treatment, would probably yield similar findings in a certain percentage of cases, with entire absence of symptoms. It is important, however, to realize the possibility of such changes, to avoid confusion with residual infective pulmonary defects.

REFERENCES

1. Boch, J. Unusual case of nontuberculous lung cavity resulting from healed lung abscess, with necropsy report. *J. Am. M. Ass.*, 1927, *88*, 646–647.
2. Farrell, J. T., Jr. Roentgenographic appearance of thorax after rib resection for pulmonary abscess. *J. Am. M. Ass.*, 1931, *97*, 1939–1943.
3. Fischer-Wasels, B. Die Pathogenese des nichttuberculösen Spontanpneumothorax. *München. med. Wchnschr.*, 1927, *74*, 1877.
4. Franklin, R. M. Bronchographic study of apparently healed lung abscesses. *Am. J. M. Sc.*, 1939, *198*, 95–98.
5. Freedman, E. Emphysematous blebs and bullae. Am. J. Roentgenol. & Rad. Therapy, 1936, *35*, 324–333.
6. Hayashi, J. Ueber tötlichen Pneumothorax durch Infarkt und Emphysem. *Frankfurt. Ztschr. f. Path.*, 1914, *16*, 1–36.
7. Jäderholm, K. B. Ein Fall von bullösem Emphysem. *Acta radiol.*, 1932, *13*, 51–53.
8. Laurell, H. Ein Beitrag zur Deutung der sogenannten Ringshatten in den Lungen. *Acta radiol.*, 1929, *10*, 72–119.
9. Peirce, C. B., and Dirkse, P. R. Pulmonary pneumatocele (localized alveolar or lobular ectasia). *Radiology*, 1937, *28*, 651–667.

DIFFICULTIES IN THE ROENTGENOLOGICAL EXAMINATION OF THE BILIARY TRACT

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THE value of cholangiography in the diagnosis of lithiasis of the main bile duct is unquestioned. This was really the object pursued when it was first performed, and is the motive of its continued employment.

At present, however, there is the tendency to use this exploratory procedure as a method to ascertain the physiology and pathological disturbances of the biliary tract, often ignoring useful knowledge obtainable from other procedures.

For this purpose, cholangiography is undoubtedly of great help and sometimes affords useful lessons, but it can also lead to error if incorrectly interpreted.

If it is sometimes difficult to determine the existence of an intracanalicular concretion, it is naturally much more so to ascertain the functional activity or discover a disorder.

Often spasms of the ducts are diagnosed, because at a certain level their shadow is obliterated or narrowed.

Peristalsis of the bile ducts is described, simply because their borders are irregular or waved.

Dystonia of the sphincter of Oddi is mentioned, because Wirsung's duct is visualized.

Syndromes of biliary dyskinesia are spoken of, by the sole observation of one or two cholangiograms taken with short intervals.

Summing up, it is sometimes thought that cholangiography is an infallible image of all that occurs in the biliary tract, forgetting that a roentgenogram is only a stationary record incapable of showing details of the dynamics of the ducts; and that, while it is true that it can give information as to the presence or absence of stones, the permeability of the ducts or their abnormalities, it does not permit us to judge of their functional activity.

Those who have performed a few cholangiographies will agree that the roentgenology of the bile tract involves serious problems. Often they have been perplexed by a shadow which may or may not be that of a stone. They have been surprised when, during a second operation, one or more concretions were found which were not demonstrated on the roentgenograms.

They want to know why the opaque medium does not penetrate the terminal portion, or why the ducts show an unusual image.

In a word, cholangiography is not always entirely satisfactory, and although prolonged study of the case sometimes throws light on the matter, by changing the quality or quantity of the contrast medium, repeating the examination and modifying the position of the patient, it is also true that at times our efforts are useless.

With the purpose of pointing out the difficulties which the interpretation of these cholangiograms present, we will study the uncertainties and errors of diagnosis in lithiasis of the choledochus, and the chapter of biliary physiopathology, as shown by cholangiography.

CHOLANGIOGRAPHY AND LITHIASIS OF THE PRINCIPAL BILE DUCT

Calculi of the bile ducts can be diagnosed by cholangiography, either because they show up directly, or because they alter the shadow of the ducts indirectly.

(1) *Direct images are those which appear at the site occupied by the stone itself, and are of two varieties:*

(a) The lacunar image, which appears when the contrast medium envelops the foreign body completely, making it stand

FIG. 1. Postmortem cholangiogram. Injection of 6 cc. of lipiodol through the cystic duct. Previously four calculi about the size of shot were placed in the bile duct. Of these only one is distinguishable by the inverted dome-shaped image seen in the upper part of the hepatic duct.

out as a transparent area in the midst of the opaque shadow. To obtain this image the stone must be in contact with the duct wall, thus preventing the medium surrounding it completely; if this should happen, the layer of medium would be thin enough not to conceal the stone.

When this layer interposed between the wall and the calculus is not thick enough to hide the concretion, it may, however, diminish its intensity, thus giving less definite images, with diffuse borders, or only slightly less opacity than the rest of the tract. In these cases interpretation becomes very difficult.

(b) When the contrast medium has not entirely enveloped the periphery of the foreign body, but only a part of its contour, dome-shaped, angular or semilacunar (border-lacunar) areas are obtained, according to the position, shape and size of the concretion.

The dome-shaped image is described as characteristic of calculi which obstruct the final portion of the choledochus, and for it to appear the concretion must be ovoid, and the contrast medium only come in contact with its upper border, or only allow a very slight passage of the injected substance. The various images depend on the shape and on the quantity of medium which manages to find its way past the stone.

The inverted dome-shaped image appears when the concretion is in the hepatic duct or one of its branches, impeding the upward passage of the medium, and which is only in contact with its lower border (Fig. 1).

FIG. 2. Same as Figure 1. Immediately afterwards a second injection of 4 cc. of lipiodol was given and a roentgenogram made. Only two stones are now visible in the hepatic duct. On opening the biliary tract the other two stones were found; one in the middle part of the choledochus, the other lodged in the ampulla of Vater.

It should be stated that sometimes calculi in the terminal part of the choledochus may present a right-angled border, or one with a slight convexity downwards, simulating a normal contraction of the sphincter of Oddi, or a complete obliteration due to extrinsic compression.

The dome-shaped image is not always due to a stone in the terminal portion; there are cases, as we shall see, in which it appears in spite of there being no obstruction. When this occurs, either in the first or following cholangiograms a normal passage of the medium into the duodenum can be seen, which is not so when it is due to a foreign body.

Finally, it must not be forgotten that a small stone, loosely lodged in the ampulla of Vater, may pass unnoticed; in this case, the stasis and reflux in Wirsung's duct may draw attention to it (Fig. 2).

Fig. 3. Postoperative cholangiography; 10 cc. of 25 per cent yodolipol. The contrast medium has filled the choledochus, the hepatic duct and its left branch; the right branch is not visible.

Fig. 4. H. C., May 7, 1942. Postoperative cholangiogram; 20 cc. of 25 per cent yodolipol. With a greater amount of contrast medium a semilacunar or border lacunar image may be seen at the division of the hepatic duct. It is due to a calculus which obstructs the right branch of this duct, impeding its filling.

The lacunar image on only one side of the duct (semilacunar or border-lacunar) occurs when the stone allows the medium to pass on only one wall of the duct, leaving a dent or wave on the opposite border.

(2) *Indirect images are those that indicate the existence of calculi, by the alterations they make on the shape of the ducts.* These may be:

(a) Dilatation of the biliary tree, a morphological alteration less related to the concretion itself than to the hypertrophy of the sphincter of Oddi.

(b) Reflux in the intrahepatic biliary system, which is not of great importance, as it may be related to any obstruction in the lower part of the choledochus, and to the quantity and pressure used in the injection of the contrast medium.

FIG. 5. Postmortem cholangiogram; 5 cc. of 25 per cent yodolipol. Previously two stones the size of shot were placed in the biliary tract; their images can be seen in the middle portion of the choledochus. Below them, several round shadows can be seen which are due to air bubbles.

(c) The failure of passage of the medium into the duodenum; also of only slight value either because of many reasons which may be responsible, or because one or several concretions are sometimes sufficient to prevent its transit into the bowel.

(d) Finally, let us mention the impossibility or difficulty of filling of one or both branches of the hepatic duct, which occurs when a stone is situated at that level and is not visible directly (Fig. 3 and 4).

The uncertainties and errors which render difficult the visualization of an intracanalicular concretion appear either because an image is badly interpreted, or because the roentgen ray itself makes the visualization difficult.

We will call the former errors of interpretation, and the latter errors of omission.

1. The errors of interpretation are due to technical defects, abnormalities of the biliary tract, edema caused by choledochitis, superimposed duodenal shadow, deformities caused by vertebrae, or any cause which hinders the correct appreciation of the image obtained.

Injection of air bubbles in the biliary tract can bring about false images; these are usually round or oval in shape, with regular edges, and show up more intensely than the calculous image, as negative areas, apart from being fugitive and displaceable, either spontaneously or by injecting more opaque substance (Fig. 5 and 6).

Bile tract abnormalities, or the space be-

FIG. 6. Postmortem cholangiogram; 8 cc. of 25 per cent yodolipol. Three more cubic centimeters of opaque medium were injected immediately afterwards and the second cholangiogram was then taken. Note how the calculous images have varied their position. In the lower part of the choledochus the air bubbles have fused into one large one. The opaque medium shows the outline of the ampulla of Vater, allowing of its visualization.

tween the branches of the hepatic duct, may cause error. Desplas, Moulonguet and Malgras mention the case of the cystic duct opening into the hepatic duct on its anterior aspect. We have a case in which the branches of the hepatic duct, outlining a negative image, might have been erroneously interpreted as a stone. In this case another roentgenogram, taken from a different angle, eliminated all doubt.

Choledochitic edema is mentioned by Desplas, Moulonguet and Malgras as the most important cause of an abnormal image. These authors mention as a means of differentiating these shadows from the truly calculous ones the fact that they are found in the middle of the dilatation and not at the end of the dilated segment, and also the variability in shape and position with which they appear in repeated roentgenograms.

Fig. 7. H. C. 12413, May 8, 1942. Postoperative cholangiogram; 25 cc. of 40 per cent abrodil. The excess of contrast medium conceals two stones in the hepatic duct.

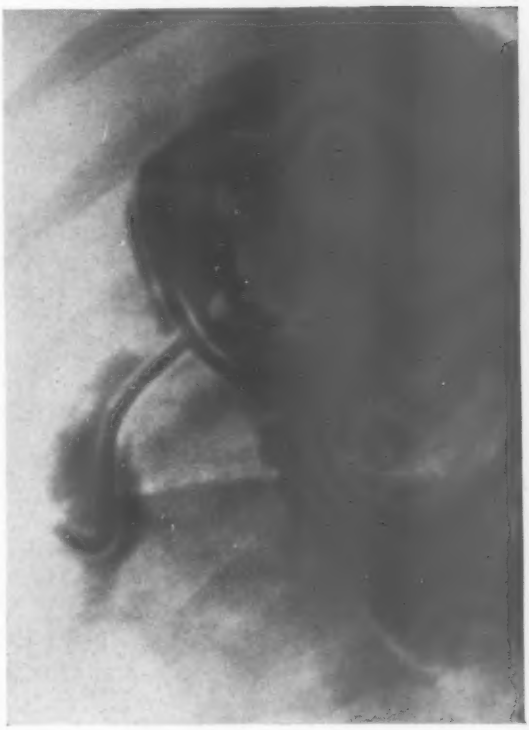

Fig. 8. H. C. 12413, May 8, 1942. Postoperative cholangiography; 25 cc. of 40 per cent abrodil. After thirty minutes most of the opaque medium has been eliminated; the images of two calculi may now be seen.

We believe the first sign to be of little value, as one or more stones lodged in the duct can produce lacunar images in the middle of the dilatation; on the other hand, we find the second sign of greater value, since the calculous shadow is generally permanent and does not vary; we say generally, because on some occasions we have found mobility and variations in the shape of its image (Fig. 8).

The superimposition of the duodenal image may not only conceal the terminal portion of the biliary duct and hide a concretion therein, but may sometimes resemble one, especially when one of the shadows made by the intestinal mucosa simulates a dome-shaped image placed exactly on the last portion of the choledochus.

Should this be the case, the passage of the

opaque medium into the intestine is an index of the absence of any obstruction in the last portion of the duct; this could be confirmed by another roentgenogram taken shortly afterwards.

The deformity produced by pressure of the vertebrae can give lacunar images by contact between the duct walls, when the ducts are displaced medially. These false images disappear or are modified either spontaneously or by increasing the quantity injected.

2. Errors of omission are those incurred when the roentgen ray does not permit the visualization of an intracanalicular concretion, and they originate either in the quality or quantity of medium used, or in the relation between the size of the calculus and the capacity of the biliary tract.

The following render visualization difficult: (*a*) poor distribution, scarcity or excess of the injected medium; (*b*) use of very opaque preparations; (*c*) small calculi lodged in dilated ducts.

Scarcity, defective distribution, and rapid passage of the medium into the duodenum do not need further explanation as causes which make visualization of a foreign body difficult. Nothing can assure us that, in a region where the opaque substance has not reached, there are not one or more calculi which have been overlooked.

Regarding the excess of medium, it may lead to the same result, dilating the biliary tract and allowing the passage of the medium between it and the stone, thus making the shadow of a stone less defined or invisible. Naturally, for this to occur, the stone must be loose in the duct, therefore one must wait for the choledochus to empty partially; then the negative image will appear as soon as the stone has come in contact with the duct wall (Fig. 7 and 8).

Excessive opacity of the contrast medium has been mentioned frequently, so we will not emphasize this difficulty; let us say only, that however thin the layer of fluid lying between the stone and the duct walls, it may be sufficient to conceal the former.

Finally, let us point out that the visualization of a calculus depends on its relative size compared to the caliber of the duct. Any small stone, lodged in a dilated tube, can be surrounded by the medium, and be easily overlooked (Fig. 7).

CHOLANGIOGRAPHY AS A METHOD OF STUDYING BILIARY PHYSIOPATHOLOGY

The utility of cholangiography as an auxiliary method to explain certain problems of physiopathology is a matter of importance. But when it is attempted to explain certain functions, or new functional syndromes are created based only on one or two roentgen studies and without considering the knowledge afforded by other methods of investigation, we believe that it is demanding too much of cholangiography.

Not only are spasms of the sphincter of Oddi mentioned as a cause of biliary stasis, but it is claimed insistently that spasms of other parts of the duct cause fleeting jaundice and biliary colics.

Roentgenologically, the activity of the two portions of the sphincter—vagotropic and sympathicotropic—are separate, and the latter's dysfunction is spoken of because Wirsung's canal is visualized when the functional value of the sphincter of the ampulla of Vater is still being discussed.

While histology denies to the principal bile path any peristaltic activity, roentgenologically it is spoken of frequently. As may be seen, roentgenological interpretation is not in accordance with facts in the face of other procedures.

In the light of that knowledge, we will study the images which appear in the terminal portion of pathological biliary ducts, and refer finally to the motility of the main biliary tract.

The intestinal portion of the biliary and pancreatic ducts is surrounded by a muscular system described in 1877 as the muscle of Oddi. In view of the relation it has with the muscular coat of the duodenum, the functional value of this sphincter has

been, and still is, discussed. Even today, there is a tendency to accept that it is capable of active function apart from the intestinal musculature.

Three parts are studied in this muscular formation: (1) the muscle of the ampulla of Vater, or sphincter of the papilla; (2) the muscle of the choledochus, or sphincter of the choledochus; (3) the muscle of Wirsung's duct, or pancreatic sphincter.

The first is a frail annular muscle which circumscribes the ampulla of Vater, a segment of the biliary tract which has suffered an involutionary process, being in the adult an insignificant portion if compared with the intestinal part of the choledochus (Fig. 9).

The second is the most important part of the sphincter of Oddi, and is a strong muscular sheath which extends from the junction of the choledochus and Wirsung's duct to above the intestinal foramen, varying in length from 8 to 15 mm. in normal cases, acquiring more length and development in pathological conditions (Fig. 10).

Fig. 9. Transverse section of the ampulla of Vater in its middle portion. ×17. Masson's trichromic stain. The ampulla is surrounded by a few muscular fibers whose importance as elements capable of stopping the bile column by their contraction must be entirely discarded. This observation is of a gallbladder obstructed by a calculus lodged in the cystic duct.

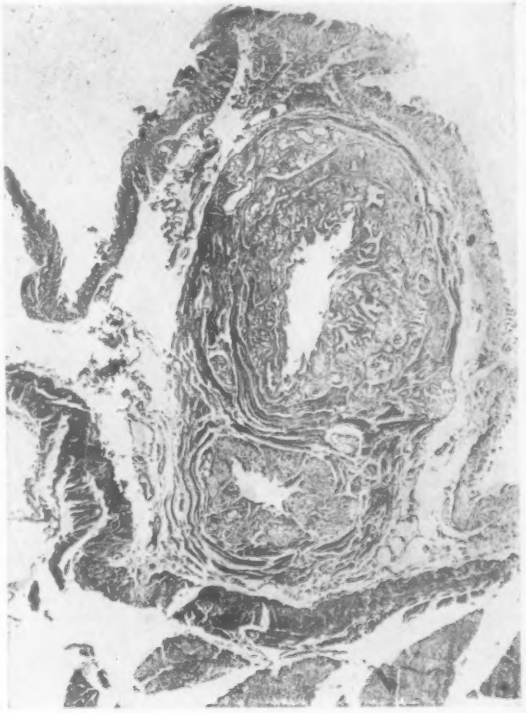

Fig. 10. Transverse section of the terminal part of the biliary and pancreatic ducts, 8 mm. above their junction. ×17. Masson's trichromic stain. The choledochus is surrounded by a strong muscular ring capable of halting the flow of bile when contracted. The muscular fibers which belong to Wirsung's duct surround only its posterior semi-circumference; therefore to call it a sphincter is incorrect. This observation corresponds to a case of lithiasis of the hepatocholedochus.

The third is the least important muscular group, and in most adults Wirsung's duct has no sphincter of its own in the sense of an intrinsic ring of muscular fibers that surround the canal entirely, for those that exist only cover its posterior semi-circumference, and do not deserve the name of sphincter (Fig. 10).

From a functional point of view, the sphincter of the papilla is not capable of offering much resistance to the passage of bile or pancreatic juice, as being a weak muscular ring and the ampulla being a very

short segment (2 mm. in length in 45 per cent of adults, according to Giordano and Mann) it is not conceivable that its contraction could detain the bile column and maintain an increased pressure in the hepatocholedochus.

In this sense we agree with Schwegler and Boyden, who not only doubt that the sphincter of the papilla can offer any appreciable resistance to the biliary and pancreatic flow, but they do not think it probable that it can participate in biliary dyskinesia.

Roentgenologically, on the contrary, it is supposed to play an active part in the production of these conditions; the visualization of Wirsung's duct is given as a sign which reveals this disorder.

It is logical that reflux of the medium into this canal, when it empties into a common ampulla with the choledochus, is only possible when at that level there is a cause which obliges the content of one duct to pass into the other. This cause may be a calculus, an excess of contrast medium or excessive pressure while injected.

These, however, are not the cases under discussion; they are those in which the filling of Wirsung's duct does not answer to any of these causes. It is in these cases that we must investigate whether the sphincter of the ampulla plays any part.

Mirizzi believes that it does, and states that visualization of the pancreatic canal is the expression of a dysfunction of this muscular ring, which he calls dystonia.

This author bases his hypothesis on the following reasons: (1) observation of two phases—complete closure of the papilla and partial opening which permits the injection of the duct; (2) progressive regurgitation of the opaque substance in the canal; (3) modification of the shape of the duct, which appears as a sinuous and dilated tract.

The first is commonly observed, but we differ in its interpretation, accepting, as opposed to Westphal's opinion, that it is not the closure of the sphincter of the papilla that causes the opaque column to halt but the contraction of the sphincter of the choledochus, which with its considerable development and strategic situation is the most indicated to detain the biliary column. Schwegler and Boyden, whose studies in histology and biliary physiology are well known, accept this hypothesis and say that it is this muscle which has the function of closing the bile duct, thus detaining the column of bile, without participation of the intestinal muscle. As an argument in their favor they quote Ivy, Voetlin and Greengard's experiment in man, which proves that the bile column can be detained in spite of an abundant flow of pancreatic fluid; this would not occur if it were the sphincter of the papilla that controlled the flow of bile.

The progressive reflux of the contrast medium into the canal, if it does speak in favor of the active nature of the phenomenon, is not commonly observed except when it can be due to other causes which disturb the biliary flow.

Lastly, the morphological changes of the duct can be determined by any factor which permits bile to penetrate the pancreatic duct during a certain length of time.

According to Mirizzi's hypothesis, the functional disorder which allows Wirsung's duct to be visualized is due to partial contraction of the sphincter of the papilla during the act of biliary expulsion, while normally it should be entirely relaxed.

Following this line of thought one should admit that if the sphincter of the papilla offers resistance to the bile flow during its partial contraction, this resistance would increase in the case of total contraction; this we have stated is questionable, and consequently so is its participation in these dyskinetic conditions. The penetration of bile in the pancreatic canal can be produced by any cause existing in the ampulla of Vater that impedes the flow of bile; this need not necessarily be a stone or a contraction of the sympathicotropic segment of Oddi's sphincter; it can be of any other nature.

Histology of the ampulla of Vater in pathological cases has taught us that cer-

tain anatomical alterations may be present which obstruct the passage of bile and may favor its penetration into Wirsung's duct.

In Vater's ampulla, there exist normally mucosal folds that not only act as valves impeding the backward flow of bile but are also capable, when very marked, of opposing certain resistance to its passage (Fig. 11).

Even more important is the hyperplasia of the mucosa, reaching occasionally such development that one must admit it as a factor capable of promoting penetration of bile into the pancreatic duct (Fig. 12).

We do not wish to signify that these reasons are valid in every case; we only propose that they be taken into account when the causes that favor reflux are under discussion.

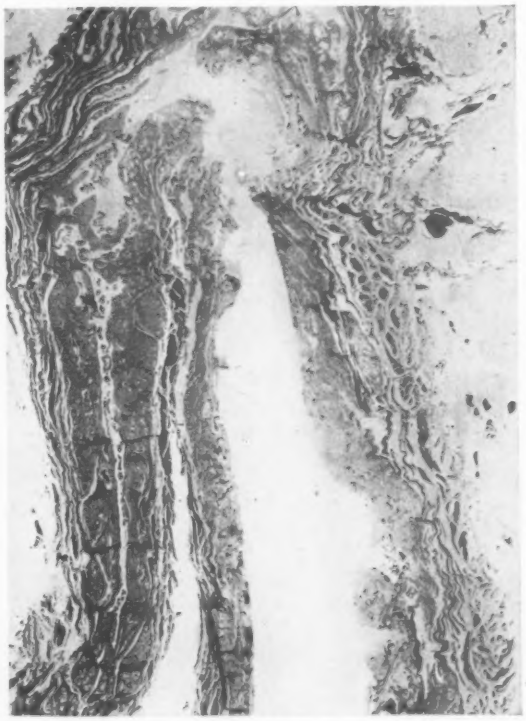

Fig. 11. Longitudinal section of the ampulla of Vater and the biliary and pancreatic ducts. On the left the choledochus, on the right Wirsung's duct. Note at the level of the ampulla, the existence of valves whose function it is to impede the reflux of bile, but which, being overdeveloped, offer some resistance to its natural flow, thus causing reflux into the pancreatic canal. In this observation a well developed valve may be seen at the end of the septum between the choledochus and Wirsung's duct, capable of closing the entrance to Wirsung's duct and obstructing the passage of bile into it.

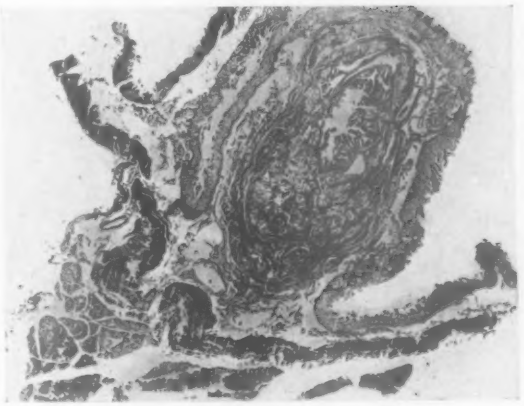

Fig. 12. Transverse section of the ampulla of Vater near its middle portion. ×10. Note the considerable increase of accessory glands which almost close the lumen of the canal.

The sphincter of the choledochus is, as has been stated, the more important part of the muscle of Oddi, and in accordance with Schwegler and Boyden we accept that "it is this muscle which causes repletion of the gallbladder during intervals between meals, and which, when overstimulated during certain physiological and pathological conditions, produces clinical entities known as dyskinesias or dysynergias of the biliary tract."

This musculature is usually hypertrophic in those cases in which the gallbladder is not functioning or when there is lithiasis of the main duct.

Roentgenologically the contraction of this annular muscle is frequently observed, suddenly detaining the opaque column, giving rise to a variable image.

This generally adopts the shape of a thimble with its convexity downwards, and if some contrast medium has passed into the duodenum, it is separated from it by a variable space (Fig. 13).

Sometimes the contracted sphincter produces in the terminal portion of the choledochus an infundibular image, ending in a more or less blunt point (Fig. 16 and 17).

FIG. 13. Postoperative cholangiogram. Twenty cubic centimeters of 40 per cent abrodil. The sphincter of the choledochus is contracted, and the terminal portion of the bile duct shows a thimble-shaped image with an inferior convexity. Wirsung's duct has filled, but its terminal portion which lies parallel to the choledochus is not shown. The pancreatic canal shows a suspended image.

Less frequently, the last part of the biliary duct ends abruptly at right angles.

It is easy to see that, when Wirsung's duct is visualized while the sphincter of the choledochus is contracted, part of the pancreatic duct which runs parallel to the choledochus is not visible. The explanation is that the fibers that surround the pancreatic duct while it is in contact with the bile duct are common to both, and their contraction occludes them simultaneously; thus only the proximal part of Wirsung's duct is visible, as it lacks muscular fibers (Fig. 13).

We have already mentioned that the contraction of the choledochus detains the bile column.

Roentgenographically this can be observed: when this muscular group is contracted, the terminal portion of the choledochus is seen at a higher level than that which corresponds to the junction of the biliary and pancreatic canals. This space corresponds to the contracted sphincter and it may well measure its length (Fig. 13, 14 and 15).

When the sphincter of the choledochus is relaxed one can then see the terminal portion of the biliary duct which varies normally between 8 and 15 mm.

This portion usually has the appearance of a canal which gradually narrows until it opens into the duodenum; this should not surprise us if we remember that the intestinal part of the choledochus diminishes progressively in caliber as it approaches the ampulla of Vater.

This canal can follow the direction of the duct and originate symmetrically from the

FIG. 14. Postoperative cholangiogram. Twenty cubic centimeters of 40 per cent abrodil. Sixty seconds afterwards a second cholangiogram is taken. The sphincter of the choledochus starts to relax allowing the passage of the medium into the duodenum.

dilated portion above, or deviate or be excentrically situated with regard to the upper segment (Fig. 15).

In pathological biliary tracts, it is frequently seen that the caliber of this segment is so diminished that it is converted into a filiform pathway; this can be explained knowing the changes undergone by the anatomical elements of its walls, of which the most interesting in our opinion is hyperplasia of the mucosa, which by increasing its thickness reduces the lumen very considerably (Fig. 17). Roentgenographically these images are easily mistaken for those given by constricting pancreatitis.

Fig. 15. Postoperative cholangiogram. Twenty cubic centimeters of 40 per cent abrodil. Three minutes afterwards a third cholangiogram is taken; the sphincter of the choledochus has relaxed completely emptying the biliary and pancreatic tracts. Compare this cholangiogram with Figure 13 and note that the terminal portion of the choledochus is visible in the latter at a higher level than what corresponds to the function of the biliary and pancreatic ducts, as may be seen in this cholangiogram. This space corresponds to the part of the biliary duct surrounded by the muscle of the choledochus, and may well measure its length.

Fig. 16. H. C. 47.977. Postoperative cholangiogram. Ten cubic centimeters of 40 per cent abrodil. Cholangiogram taken one minute after giving the injection. The sphincter of the choledochus is contracted. The last portion of the bile duct gives an infundibular image ending in a blunt extremity.

Inversely, in some cases this portion of the duct is visible as a canal only slightly narrower than the part of the choledochus above the sphincter, allowing a very rapid passage of the contrast medium, thus making visualization of the biliary tree difficult. In these circumstances, a slight degree of muscular atony should be suspected, allowing of rapid emptying (Fig. 18 and 19).

Visualization of the ampulla of Vater is always difficult; however, sometimes it can be distinctly seen, when it has emptied and only a small amount of opaque substance delineates its outline.

These images described, which correspond to the contractions and relaxations of the sphincter of the choledochus, have been thus interpreted by us, and confirmed

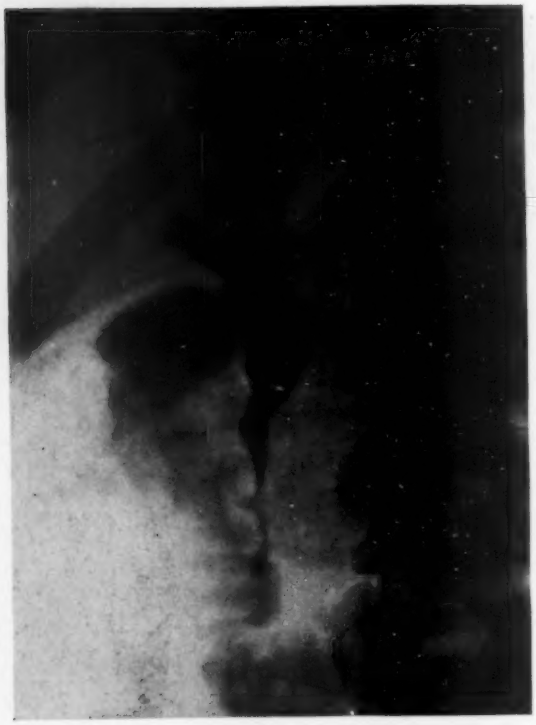

FIG. 17. H. C. 47.977. Postoperative cholangiogram. Twenty cubic centimeters of 40 per cent abrodil. Ten minutes after the injection was given the sphincter of the choledochus has relaxed, showing a filiform canal.

by the histological study carried out by one of us; so it is surprising to us to find that they are often attributed to dyskinesia and pancreatopathy.

The sphincter of the choledochus is held responsible for biliary retention when the surgeon cannot find during the operation either calculi, pancreatic lesions, or any other known cause to explain the disturbance.

These cases of jaundice have been attributed to obstructions in the free biliary circulation and localized in the last part of the choledochus, and may be functional and organic.

Cholangiography can afford useful lessons in these cases, especially when a prolonged stasis of the contrast medium is found. The image of the terminal portion of the bile duct is, in our judgment, much less important.

Difficulties begin when one tries to determine the cause of the biliary retention. A halt in the opaque column may be due to a normal contraction, a spasm of the sphincter or an anatomical lesion of the walls of the final segment of the choledochus, which obstructs its lumen, excluding naturally an obstacle such as neoplasm, stones or extrinsic compression.

Roentgenologically there is no difference between the appearance of a normal contraction and that of a spasm of the sphincter; the latter is to be suspected when there is a stasis lasting fifteen or twenty minutes. But is that period of time sufficient to differentiate the normal from the pathologic? Cannot a contraction of the sphincter be of a longer duration than usual and still have no abnormal significance? And is not this supposition more probable when one is dealing with diseased bile tracts?

Most of the ducts we examine by this method are pathological, with evident alterations in the structure of their final portion; it is only logical to think that they jeopardize the normal function of the sphincter.

This, we believe, is how the hypertrophy of the musculature of the sphincter acts, which is so frequent when the gallbladder is excluded from functioning.

This increase of muscular tissue can easily be a cause of hypertonia of the sphincter, and should be considered an adaptation to the new physiological conditions imposed upon the main bile path, and which is compatible with perfect health.

It is possible that this increased obstacle to the flow of bile determined by an increase of tone of the sphincteric musculature is not permanent. This is proved by certain patients in whom it appeared in the first examination, but one or more days later the contrast medium passed into the duodenum easily a few minutes after injection.

Evidently, the problem existent in these cases is a complicated one, and we admit that it cannot be solved with two or three roentgen examinations at short intervals,

or with only one examination, because results may be entirely different on repetition.

There are no doubt cases in which it is not a functional factor which determines the biliary stasis, but certain abnormalities of the distal portion of the choledochus which give rise to canalization difficulties of a permanent nature capable of disturbing the flow of bile.

Microscopic anatomical studies of the pathological ducts have shown us the existence of serious structural modifications, such as hyperplasia of the accessory glands, which growing toward the lumen of the canal, narrow it as much as to almost make it disappear in given sections; the sclerosis of the mucosa which in the shape of fibrous bands fills the space between crypts and glandular ducts; the sclerosis of muscular tissue and the hypertrophy of musculature which is sometimes so intense that the greater part of the duct is formed by it.

Fig. 18. H. C. 11.672. Postoperative cholangiogram. Twenty cubic centimeters of 40 per cent abrodil. The relaxation of the sphincter of the choledochus has not allowed the biliary tract to fill, as the contrast medium has passed rapidly into the duodenum. Twenty cubic centimeters more of abrodil was injected, with greater pressure, and Figure 19 was taken.

Fig. 19. H. C. 11.672. Postoperative cholangiogram. Twenty cubic centimeters of 40 per cent abrodil. The terminal part of the biliary duct is wide open, and its caliber appears only slightly narrower than that of the remainder of the duct. In the left branch of the hepatic duct the images of two calculi can be seen.

These morphological changes, by themselves or associated with functional disorders, may cause cholestasis and probably each inflammatory episode increases this impediment by hyperemia and edema.

This explains certain syndromes of the choledochus without stones in the main biliary tract, and even cases of cholelithiasis in which the calculus does not participate mechanically in the obstruction (Fig. 20).

Finally we will refer to the motility of the biliary tract.

If the motor function of the accessory

FIG. 20. H. C. 11.066. Postoperative cholangiogram. Twenty cubic centimeters of 40 per cent abrodil. M. G., aged forty-one. The first painful episode, accompanied by jaundice, appeared at the age of thirty-eight, passing off after three months of medical treatment. Three months ago another crisis of pain, jaundice and remaining signs of retention of pigments and salts became manifest. An operation was performed on June 1, 1940, with the diagnosis of lithiasis of the hepatocholedochus. The gallbladder contained no calculi, but was cut off from the biliary circulation. A dilated choledochus was found to contain a large amount of inspissated bile and sediments; probing did not reveal calculi but the terminal portion could not be catheterized. There was no evident alteration of the pancreas. A cholecystectomy and drainage of the biliary tract with Kehr's tube were performed. Fifteen days later roentgen study of the bile duct showed a delayed passage of the contrast medium into the duodenum. This result was obtained in successive explorations which made us suspect the existence of stenosis of the duct. The patient was finally cured after a bilidigestive anastomosis was performed.

tract is no longer questioned, that is not the case with the principal one; here once again there arises a difficulty in discussion as regards microscopic anatomy and cholangiography.

Muscular tissue, with the exception of that of the sphincter of Oddi, is present in the conductive system in so small a quantity that its functional importance is nil. Histology has shown that the muscular elements that participate actively are isolated longitudinal bundles, separated by large zones where that tissue is absent.

The choledochus, particularly, has the greater amount of muscular fibers, especially in the distal portion of the duct.

The circular fibers are scarcer than the longitudinal ones; they are scarcer in the hepatic duct than in the choledochus; in this duct, they are more numerous in the lower part of its extramural portion. Knowing the quantity and distribution of this tissue, we do not believe it probable that it can convey motility to the biliary canal.

Lütkens, in a chapter concerned with the histology of the conductive system, says, referring to the scarcity of muscular fibers in the hepatic ducts, that "it is impossible to attribute any special functional importance to these scanty elements"; and goes on to say that in the choledochus only the muscular bundles near the sphincter can cooperate in the act of bile expulsion.

Nuboer, speaking of the factors which cause the passage of bile into the intestine, refers to the muscular contraction of the common duct, among others, and says that "the small quantity of muscular fibers and the length of the canal make this supposition most improbable."

In favor of the unimportant part that the muscular element plays in the principal biliary tract, we mention the fact that in those cases in which there is an obstruction in the last portion of the choledochus, cases which should show a functional hypertrophy of the musculature, it is not markedly increased.

Only in a small number of cases, one must admit a certain motility, localized in the distal part of the choledochus, which is where there is greater development of the musculature and especially of circular muscle fibers.

Roentgenologically, we have seen, though very rarely, certain irregularities of the

borders of the canal, located at that level, which must be interpreted as waves of contraction (Fig. 21 and 22).

Other modifications of the images which have been described as characteristic of the existence of motility are due, we believe, to errors of interpretation related to the quantity and quality of the contrast medium used.

The use of a small amount of the contrast medium and the employment of very viscous substances can produce these images, as we have found in cholangiograms of the cadaver, where of course no activity can be invoked.

Fig. 21. H. C. 12.455. Postoperative cholangiogram. Thirty cubic centimeters of 40 per cent abrodil. Note in the terminal portion of the choledochus certain irregularities in the borders of the duct which must be attributed to contractions of the circular muscle fibers existing at this level. In favor of their active nature there is the fact of their disappearance in the next roentgenogram (Fig. 22) taken one minute later. The dome-shaped image appearing in the terminal portion of the choledochus is not due to a stone, as it is not present in Figure 22. This cholangiogram was taken twenty minutes after injection of the opaque medium; up to that time no passage into the duodenum had taken place.

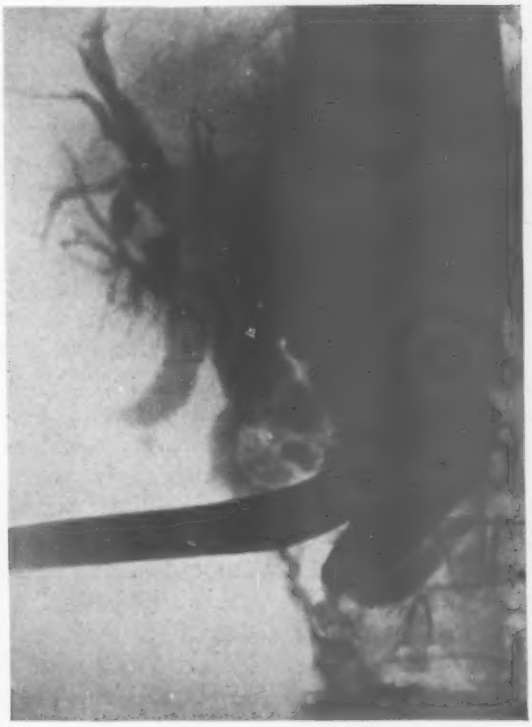

Fig. 22. H. C. 12.455. Postoperative cholangiogram. Thirty cubic centimeters of 40 per cent abrodil. Taken one minute after Figure 21. The terminal portion of the choledochus shows regular borders; the dome-shaped image has disappeared and opaque medium passes into the duodenum.

SUMMARY

Cholangiography is at the present moment a means of investigation which permits exploration of the biliary tree, with the object of verifying the existence of calculi, studying the permeability of the terminal portion of the duct, its abnormalities, apart from being a useful aid for the study of the physiopathology of the bile ducts. But it does not always fulfill its task satisfactorily, as often uncertainties appear and errors are committed because cholangiography is not infallible.

Two main problems are considered here:

1. Cholangiography related to lithiasis of the hepatocholedochus.

2. Cholangiography applied to physiopathology of the principal biliary tract.

After describing the appearances that allow us to diagnose the existence of an intracanalicular concretion, the uncertainties and errors, which make their appreciation difficult, are taken up. They originate either by faulty interpretation or because roentgenography does not permit the visualization of the foreign body. The former are called errors of interpretation; the latter, errors of omission.

Errors of interpretation are committed when there is difficulty in the correct appreciation of the images seen; they are caused by faulty technique, abnormalities of the biliary tract, edema due to choledochitis, superposition of the duodenal shadow, or deformities by compression of the vertebrae. Errors of omission are committed when the roentgenogram does not reveal the existence of an intracanalicular calculus, and are due to defective distribution, excess or small amount of the contrast medium used, to the employment of substances of great opacity or a lack of proportion between the stone and the caliber of the duct.

We have taken up the physiopathology of the bile ducts by cholangiography, based on knowledge obtained by microscopic anatomy of the ducts.

In the first place, the problem of reflux of the medium into Wirsung's duct is considered, analyzing afterwards the images of the terminal portion of the choledochus, which is surrounded by a sphincter of its own; it is confirmed by roentgen examination that it is this muscle which stops, by its contraction, the flow of bile, and maintains the pressure in the interior of the duct.

The debated question of the functional disorders of the muscle of Oddi is the object of special study, pointing out the difficulties encountered in establishing its diagnosis with the sole aid of cholangiography. Many spasms of the sphincter must be considered intimately related to the anatomical alterations of the sphincteric musculature, which is generally hypertrophic in diseased biliary canals. This functional hypertrophy, capable of causing hypertonia of the sphincter, is compatible with perfect health.

There are other cases in which the disorder of canalization is not due to a functional cause, but to a number of organic alterations, which generally coexist and prevent free circulation of the bile.

Finally, reference is made to the motility of the main bile tract, precluding this duct from any peristaltic activity, except the lower part of the extramural portion of the choledochus, where motility can sometimes be observed.

REFERENCES

1. ACEVEDO, E. Litiasis del colédoco. Tratamiento. XI Congreso Argentino de Cirugía. 1939.
2. BÉRARD, L., and MALLET-GUY, P. L'exploration radiologique des cholécystostomies. *Rev. de chir.* 1929, *67*, 614–646.
3. DESPLAS, B., MOULONGUET, P., and MALGRAS, P. L'exploration radiologique postopératoire de la voie biliaire principale. Masson et Cie, Paris, 1938.
4. GIORDANO, A. S., and MANN, F. C. Sphincter of the choledochus. *Arch. Path. & Lab. Med.*, 1927, *4*, 943–957.
5. HICKEN, N. F., BEST, R. R., and HUNT, H. B. Cholangiography; visualization of gallbladder and bile ducts during and after operation. *Ann. Surg.*, 1936, *103*, 210–229.
6. MALLET-GUY, P., and FRIEH, P. Sur une cause d'erreur dans l'exploration lipiodolée du transit biliaire. *Lyon chir.*, 1937, *34*, 580–582.
7. MIRIZZI, P. L. Fisiopatología del hepato-colédoco: Colangiografía operatoria. El Ateneo, Buenos Aires, 1939.
8. NEGRI, A. Histofisiopatologia de las vias biliaires. Buenos Aires, 1941.
9. SCHWEGLER, R. A., JR., and BOYDEN, E. A. Development of pars intestinalis of common bile duct in human fetus, with special reference to the origin of the ampulla of Vater and the sphincter of Oddi. III. Composition of musculus proprius. *Anat. Rec.*, 1937, *68*, 193–219.

MARCH FRACTURE

AN ANALYSIS OF 166 CASES

By LIEUTENANT COLONEL FURMAN H. TYNER
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SINCE the condition was first described by Breithaup, in 1855, numerous cases of march fracture have been reported in the European literature. In recent times, however, coincident with the growth of our armies, substantial series of march fractures have been reported in American journals.

The term "march fracture," as it is generally understood, applies to those fractures of the metatarsal bones which occur without great trauma, during a march.*

From April 1, 1941, to June 10, 1943, we have had the opportunity of studying 166 cases of march fracture of the metatarsal bone, and because of the frequency of this condition, we have become interested in its etiology and pathogenesis.

All current theories concerning the production of march fractures give due importance to the small repeated traumata incurred in long marches. All authors, however, agree that some other factor must be concerned before march fractures occur. "Physiologically inadequate" feet, abnormal length of the fractured metatarsals, overload, neurogenic influences, inflammatory processes, and the handicap of a previously sedentary occupation of the patient have been mentioned as possible causative factors.

In our cases, we have made an effort to evaluate these possible causes, and, in addition, we have studied calcium and phosphorus metabolism in 12 cases, with the possibility in mind that an altered bone nutrition might have had some influence in the production of the fractures.

* We have seen two march fractures of the pubes, one of the femoral neck, and one of the supracondylar area of the femur during the past twenty-five months.

In 20 of our cases, we were also able to secure accurate information as to the time that the fractures occurred after the beginning of the march.

Our 166 cases of metatarsal fractures occurred in 155 patients—2 had bilateral fractures and 9 had multiple unilateral fractures.

TABLE I

FOOT INVOLVED IN 155 CASES OF MARCH FRACTURES

	Number	Percentage
Right	89	57.4
Left	66	42.6
Total	155	100

TABLE II

METATARSAL INVOLVED IN 166 MARCH FRACTURES (155 patients)

Metatarsal	Number	Percentage
Second	60	36.2
Third	90	54.2
Fourth	13	7.8
Fifth	3	1.8
Total	166	100

As seen in Table I, the right foot was involved in 89 cases (57.4 per cent), whereas the left was involved in 66 cases (42.6 per cent). The metatarsals involved were as follows (Table II): first metartarsal, none; second metatarsal, 60 cases (36.2 per cent); third, 90 cases (54.2 per cent); fourth, 13 cases (7.8 per cent), and fifth, 3 cases (1.8 per cent).

Most fractures occurred in the middle and distal thirds of the involved bone. Ninety, or 54.2 per cent, occurred in the distal third; 73, or 44 per cent, occurred in the middle third; and 3, or 1.8 per cent, occurred in the proximal third. The most frequent site of fracture was at the distal third of the right third metatarsal, with 31 cases. There were 29 cases involving the distal third of the left third metatarsal.

The age distribution appears closely correlated to the age distribution in the Army, and is therefore not considered of significance in the etiology. No neurological disturbances or infections could be discovered in any of our cases.

TABLE III

BLOOD CHEMISTRY IN 12 CASES OF MARCH FRACTURE

Case Number	Serum Phosphorus	Phosphatase	Serum Calcium	Cevitamic Acid
Normal	3–4 mg. per 100 cc.	10 units	9–11 mg. per 100 cc.	0.75 mg. per 100 cc.
1	4.1	8.1	12	0.44
2	3.2	6.2	11	0.51
3	3.7	4.8	10.7	0.54
4	2.9	5.0	10.9	0.61
5	2.8	8.4	11.8	0.47
6	4.0	8.9	11.9	0.81
7	4.4	7.8	9.2	0.40
8	3.02	4.8	11.4	0.50
9	3.6	4.08	11.1	0.42
10	3.8	5.98	11.9	0.54
11	3.7	6.7	11.2	0.68
12	3.1	7.0	11.4	0.47
Average	3.5	6.48	11.2	0.49

Prior occupation and length of service were studied in 20 cases in an effort to discover any possible causative factor, such as sudden subjection of a little used foot to strenuous weight bearing and marching activities. Length of service in these 20 cases averaged thirty-seven and one-half weeks. The duration of training time spent taking long hikes and forced marches averaged twenty-seven weeks. The average time between first symptoms and appearance at the roentgen department for roentgenograms of the foot averaged twenty days, although the extremes varied from a few hours to ninety days. The patients' former occupations ranged from coffin making to dress designing, and did not appear of significance.

The 20 cases were interviewed personally. They reported that they had completed several miles of marching, and that muscle fatigue had set in before the onset of symptoms. The distance marched before the pain of fracture occurred averaged 11 miles.

Sirbu and Palmer[1] have suggested that the so-called "atavistic foot," with a relatively short first metatarsal, is a causative factor in the production of march fractures. On casual inspection of the roentgenograms in our series, all appeared to have appreciable shortening of the first metatarsal. However, careful measurements did not bear out this observation. Fifty normal feet and the 157 feet with march fractures were measured in the following manner (see Fig. 3): A line was drawn from the distal end of the first to the distal end of the fifth metatarsal, utilizing the dorsoplantar roentgenogram. The distance between the point where this line crossed the shaft of the second and the distal end of the second was then taken as an index of the relative shortening of the first metatarsal. This measurement index averaged, in the normal foot, 10.7 millimeters. In the fractured feet this index measured 10.0 mm.

The location of the sesamoid bones, in relation to the distal end of the first metatarsal, appeared likewise to remain practically constant in both normal and fractured feet.

In a further attempt to discover an etiological factor for the occurrence of these fractures (aside from that of repeated subthreshold trauma), 12 patients were studied from the standpoint of blood chemistry, with the following results (Table III): blood phosphorus (Fiske and Subarrow method) averaged 3.5 mg. per 100 cc. (normal 3–4 mg.); blood calcium (Clark Collip method)

Fig. 1. *A*, march fracture in distal end of third right metatarsal. *B*, same case, twenty-six days later.

Fig. 2. *A*, bilateral march fractures in white soldier, aged nineteen, right foot; note periosteal proliferation along medial surface of shaft of third metatarsal. *B*, left foot of same patient, roentgenogram taken same day as *A*. Note similarity to osteogenic sarcoma of periosteal type.

averaged 11.2 mg. per 100 cc. (normal 9–11 mg.); fasting cevitamic acid levels averaged 0.49 mg. per 100 cc. (normal 0.75 mg.) with a high of 0.81 and low of 0.42 mg. per 100 cc.

Serum phosphatase levels, as determined by the modified Bodansky method averaged 6.48 units. (The normal in adults is usually considered as any level up to 10 units. Youmans and Patton,[2] however, report values in the general population of from 1.5 to 5.0 units.) The slight increase of phosphatase in our series can probably be considered due to the stimulus of healing fractures.

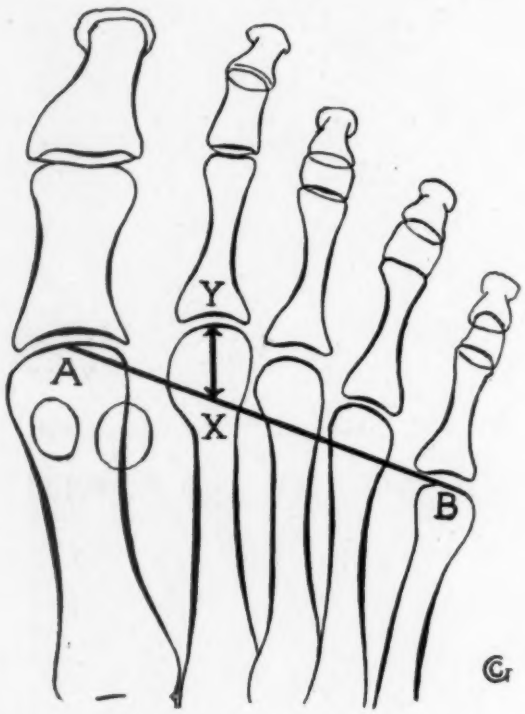

Fig. 3. Diagram to show method of measuring relative foreshortening of first metatarsal. Line *AB* connects the central points of the distal articular surfaces of the first and fifth metatarsals. Line *XY* measures the distance from the point where *AB* crosses the shaft of the second metatarsal to the central point of its distal articular surface.

It is apparent from the study of our cases that age, previous occupation, neurological disturbances, bony anatomy of the feet, and bone metabolism cannot be considered as important etiological factors, although they may contribute to the production of these fractures in individual cases.

It seems to us that due consideration has not yet been given to the fact that bones cannot stand great stresses unless they are adequately supported by muscle. In the foot we have three complex systems of arches which rely for support on the tone of the plantar muscles and also on the tension of the tendons of the tibialis posterior and peroneus longus. One of the most important muscles in the foot is the transverse head of the adductor hallucis, which arises from the capsules of the lateral four metatarsophalangeal joints and the deep transverse ligaments, and inserts into the base of the proximal phalanx of the great toe. The action of this muscle is to adduct the heads of the four lateral metatarsal bones. This allows for flexibility across the heads of the metatarsals in walking. The heads spread when weight is thrown on them and the muscle acts much as a spring to snap them back to their original position when the foot is relieved of the weight. Loss of resiliency of this muscle would throw unusual strain on the head of the lateral metatarsals.

Anyone who has taken prolonged physical exercises knows how much less efficient muscular contractions become after the experience of fatigue. When muscles of the foot and leg are fatigued, the weight of the body is thrown directly on the metatarsal bones, while the arches are flattened by the loss of muscular tone. In addition to normal stresses which are placed on this weakened system during level marching, there are also additional stresses which occur when marching under a heavy load or over rough ground. As stated before, all of the 20 cases in which information was available experienced fatigue before the pain of fracture occurred. This makes us think that while previous occupation, relative length of the fractured metatarsal, and defective bone metabolism may be contributing factors,

muscle fatigue as it occurs during long marches is the principal cause of march fractures.

In order to illustrate the clinical symptoms, the following case histories are presented:

CASE REPORTS

Case 1. A white soldier, aged twenty-two, entered the hospital on May 26, 1943, because of pain in his right foot. He had been in the service seven months, during which time long hikes and forced marches had been a part of the routine training. Four days prior to admission, while he was on a 6 mile hike with full pack, he began to suffer dull aching pain over the dorsum of the right foot, localized over the second metatarsal area. The pain occurred while the soldier was walking over level ground and it did not radiate. He continued the hike, and the following morning there was swelling over the dorsum of the foot and walking was painful. He was inactive for three days, during which time the swelling subsided. However, pain on walking persisted and he entered the hospital for orthopedic and roentgen examination.

His parents were both living and well. Prior to induction he had worked as a mattress maker necessitating standing eight hours daily. He had had no fractures previous to this time. He stated that he ate vegetables, fruits, and the regular Army diet, gaining 20 pounds in the seven months of his service.

Roentgenograms of the foot revealed a complete, slightly comminuted transverse fracture 2.5 cm. proximal to the distal end of the right second metatarsal, with 2 mm. plantar displacement of the distal fragment (Fig. 4*A*).

Fig. 4. Case 1. *A*, right foot, May 26, 1943. March fracture of distal end of second metatarsal. *B*, twenty-three days later.

Laboratory findings were as follows: erythrocyte count, 5,120,000; leukocyte count, 7,850; Kahn reaction negative; sedimentation rate normal; urinalysis negative. Blood chemistry: phosphorus, 2.9 mg. per 100 cc.; phosphatase, 5 units; calcium, 10.9 mg., and cevitamic acid, 0.61 mg. per 100 cc.

A metatarsal bar was added to his shoe and the shoe used as a splint. A follow-up roentgenogram twenty-three days later revealed

exuberant new bone formation about the site of the fracture (Fig. 4*B*). His clinical course paralleled the roentgen findings and he was discharged after twenty-eight days' hospitalization, with the recommendation that he be excused from marching for one month.

Case II. A white soldier, aged twenty-one, entered the hospital on May 29, 1943, because of pain in his left foot. Ten days prior to admission, after making 16 miles of a scheduled 25 mile hike with full pack, he began having a dull aching pain on the dorsal and plantar surfaces of his left foot, in the region of the metatarsal arch. This aching pain radiated to his ankle and the calf of his leg so that he was forced to fall out. The following evening he attempted to go on another hike, but the pain and swelling of the left foot caused him to again fall out. Tape support was applied and the soldier managed to do light duty for ten days, at the end of which time he came to the hospital for orthopedic and roentgen examination. The latter revealed a spindle-shaped periosteal reaction about the mid-portion of the shaft of the left third metatarsal, interpreted as a march fracture of some duration (Fig. 5*A*).

The patient had been a punch press operator prior to induction, working on his feet for eight to ten hours daily. He had had a fractured rib seven years earlier. He had had five months' service, all of which was spent in strenuous physical training, including long marches and forced marches.

One brother died of nephritis, but both parents and seven siblings are living and well. The patient claims he eats all regular Army food, including fruits and vegetables.

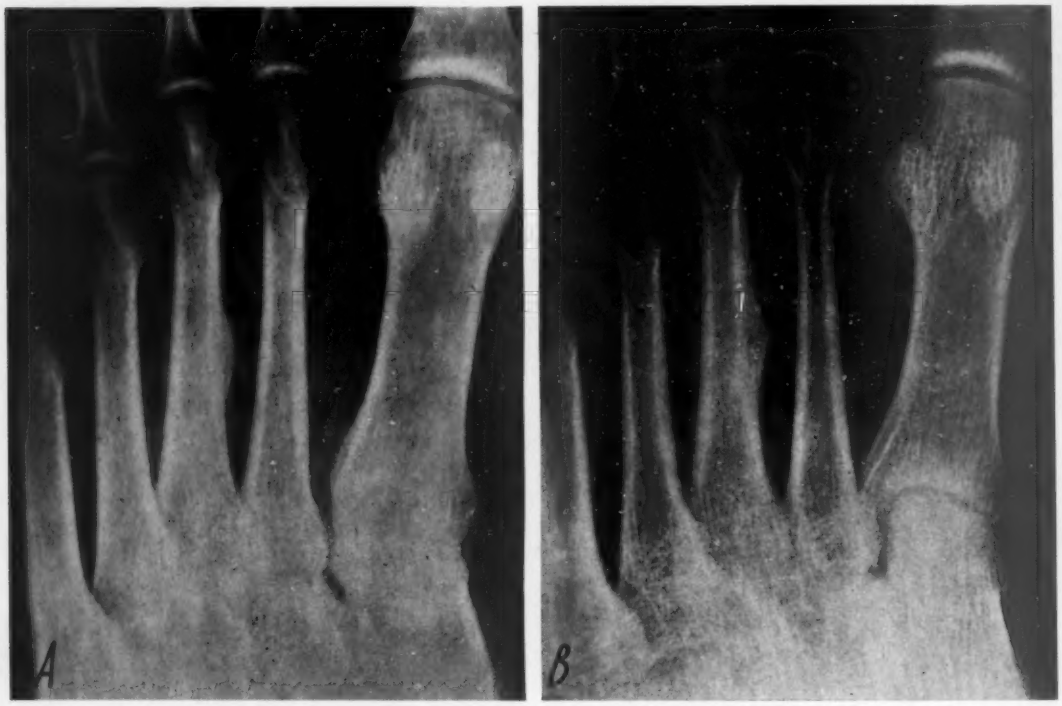

Fig. 5. Case II. *A*, left foot, May 29, 1943. March fracture of mid-shaft of left second metatarsal. *B*, eighteen days later.

Laboratory findings: erythrocyte count, 5,300,000; leukocyte count, 9,500; Kahn reaction negative; urinalysis negative; normal sedimentation rate. Blood chemistry: phosphorus, 3.7 mg. per 100 cc.; phosphatase, 6.7 units; calcium, 11.2 mg., and cevitamic acid, 0.68 mg. per 100 cc.

Patient was given sixteen whirlpool treatments and used his G.I. shoes as a splint. After eighteen days, a follow-up roentgenogram revealed considerable new bone formation about

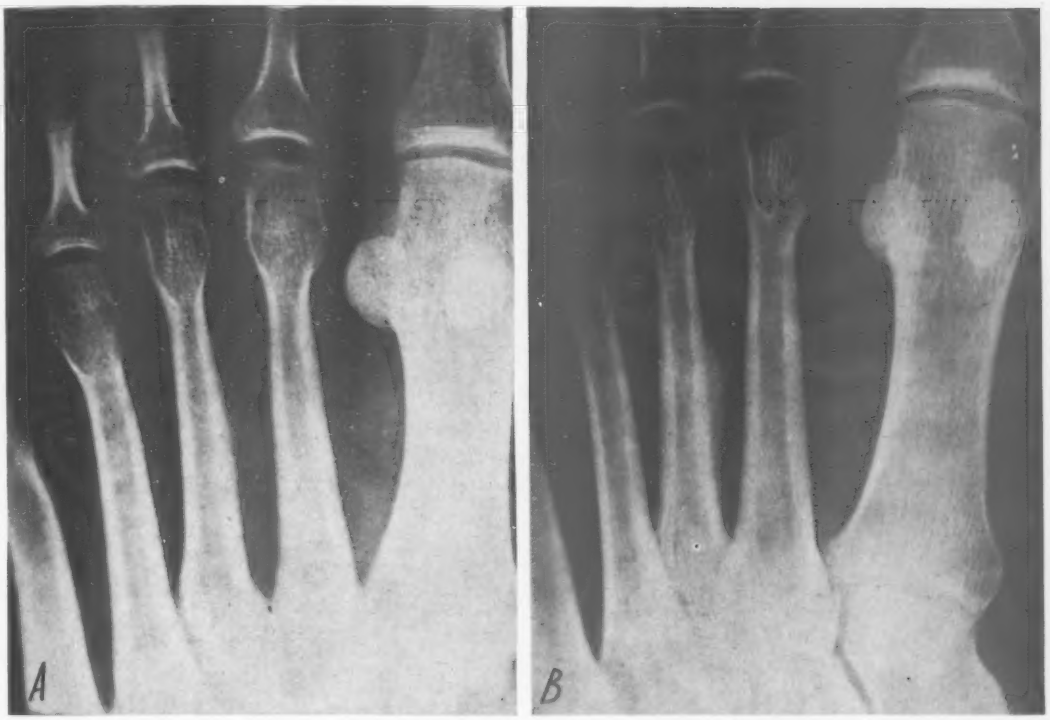

Fig. 6. Case III. *A*, left foot, June 2, 1943. Periosteal proliferation along medial surface of shaft of left third metatarsal. *B*, fourteen days later.

the mid-portion of the shaft of the metatarsal (Fig. 5*B*). The patient was improved clinically, and discharged to duty after three weeks' hospitalization.

Case III. A white soldier, aged thirty, entered the hospital on June 2, 1943, because of pain in the left foot, aggravated by marching. Five days prior to admission, while on a 16 mile hike with full pack, he noticed the onset of a burning and aching pain over the dorsum of his left foot, but continued marching. After twelve hours the foot began to swell on both the plantar and dorsal surfaces, becoming tender to shoe pressure over the mid-portion of the third metatarsal. He continued marching for two days, then came to the hospital.

The soldier had been in the Army fourteen and one-half months, fourteen of which had been spent in physical training, including long marches. Prior occupation was farming. His father died of cancer at the age of fifty. His mother and three siblings are living and well. He states that he eats regular Army food, with generous amounts of fruits and vegetables.

Roentgenograms revealed periosteal proliferation and a fine fracture line through the superomedial surface of the mid-portion of the shaft of the left third metatarsal (Fig. 6*A*).

Laboratory findings: erythrocyte count, 4,800,000; leukocyte count, 8,050; sedimentation rate normal, and Kahn reaction negative. Calcium oxalate crystals were found in the urine on one examination only, otherwise urinalyses were negative. Blood chemistry: phosphorus, 3.02 mg. per 100 cc.; phosphatase, 4.8 units; calcium 11.4 mg., and cevitamic acid, 0.50 mg. per 100 cc.

After fourteen days a follow-up roentgenogram revealed extensive new bone formation along the proximal two-thirds of the shaft of the left third metatarsal (Fig. 6*B*), and the patient remains hospitalized at the time of this writing.

SUMMARY AND CONCLUSIONS

1. A study of 166 cases of march fracture of the metatarsal bones is reported.

2. Possible etiological factors were studied.

3. The authors believe that increased stress on the metatarsal bones, induced by muscular fatigue, is the most important factor in the production of such fractures.

Photographic prints were made by Mrs. Herbert Beach, Jr., R.T.

REFERENCES

1. Sirbu, A. B., and Palmer, A. M. March fracture; report of 15 cases. *California & West. Med.*, 1942, *57*, 123–127.
2. Youmans, J. B., and Patton, E. W. Nutritional Deficiencies. J. B. Lippincott Co., Philadelphia.
3. Cunningham. Textbook of Anatomy. Seventh edition. Page 307.
4. *Ibid.*, page 373.

ROENTGENOGRAPHIC STUDIES OF THE CERVICAL SPINE

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THE cervical spine is designed primarily to allow extremes of mobility while supporting the weight of the skull balanced on a relatively narrow base. At the same time its foramina transmit the roots of the brachial plexus. These peculiarities of structure and function predispose this level of the spine to sprains, partial dislocations, and nerve root irritation more than the lower, more stable, weight-bearing portion.

THE ANTERIOR CURVE

A lateral roentgenogram of the normal cervical spine at rest reveals the bodies arranged in a symmetrical anterior curve. Their posterior surfaces form the anterior wall of the spinal canal while its posterior wall is marked by the sections of the arches at their mid-point. These likewise are arranged in a symmetrical anterior curve. The diameter of the canal increases from below upward toward the base of the skull to accommodate the medulla. In the absence of trauma the cervical spine maintains its anterior curve even in cases with advanced arthritis or disc degeneration.

Upon anterior flexion of the normal neck, the curve is reversed but it always remains symmetrical at all points. In the cadaver specimen it is impossible even by counter pressure to produce angulation at one point without cutting the posterior joint capsules.

ANGULATION

Following severe trauma, often of a "snap-the-whip" character, the normal anterior curve may become replaced by angulation of the cervical spine forward at one point. This indicates a partial bilateral subluxation of the corresponding posterior joints usually with muscle spasm.

Cases of recent subluxation may show considerable decrease in the angulation after receiving appropriate treatment for a few weeks. Lesser degrees of injury may show only as a straightening of the anterior curve, but forward angulation indicates a more severe injury.

It is usually possible to identify the upper articular surface of the joint where it has become displaced forward upon the articular surface below. Also the posterior joint space is wider in back and narrow in front from the forward tipping of the vertebral body. But in posterior displacement the joint is wider in front (see Fig. 1). If the subluxation is recent, no bony bridging has taken place, but after two months, calcification in the anterior longitudinal ligament may begin to bridge the intervertebral space in an attempt to stabilize this weakened level of the spine. The intervening disc may have become thinned. Complete fusion of the adjacent vertebral bodies may result with final absorption of the intervertebral disc (Fig. 2).

Unilateral subluxation is more difficult to visualize but the forward type may present one or more of the following features: (1) shift of the spinous process toward the side of the subluxation; (2) slight increase in the size of the corresponding intervertebral foramen; (3) encroachment of the opposite foramen; (4) displacement of the articular surfaces upon each other as seen in the lateral stereoscopic studies made with a longitudinal shift, and (5) the intervertebral disc space as seen in the posteroanterior view, thicker on the involved side.

The posteroanterior view, according to the method of Jacobs, is made with the patient lying down, on the Bucky diaphragm, forehead on a sand bag, and the head held by a fixation band. The central ray is vertical over the atlanto-occipital joint. The patient moves the jaw rapidly while holding the head absolutely still for a relatively

long exposure. Such a posteroanterior roentgenogram will show not only the alignment of the spinous processes and the thickness of the discs, but also the posterior articulations and the pedicles with their interpediculate distance representing the size of the foramina. In some cases these foramina are constricted and the interpediculate distance is consequently decreased.

In the posteroanterior view, the posterior articulations are seen laterally on each side. They sometimes show an asymmetry in the direction of their planes. Normally the plane of the articulation is transverse and slanting with its upper edge anterior and its lower edge posterior. However, it is not unusual for the articular plane on one side to be more horizontal or more vertical than that on the other. This condition necessarily results in some asymmetry of function.

Backward subluxation with preternatural mobility may rarely result from previous injury. When this occurs the posterior margin of the upper vertebral body is seen behind the plane of the lower body. In this position the superior articular process from the vertebra below thrusts forward encroaching upon the intervertebral foramen. In anterior flexion, the relation between the vertebral bodies is normal (Fig. 1).

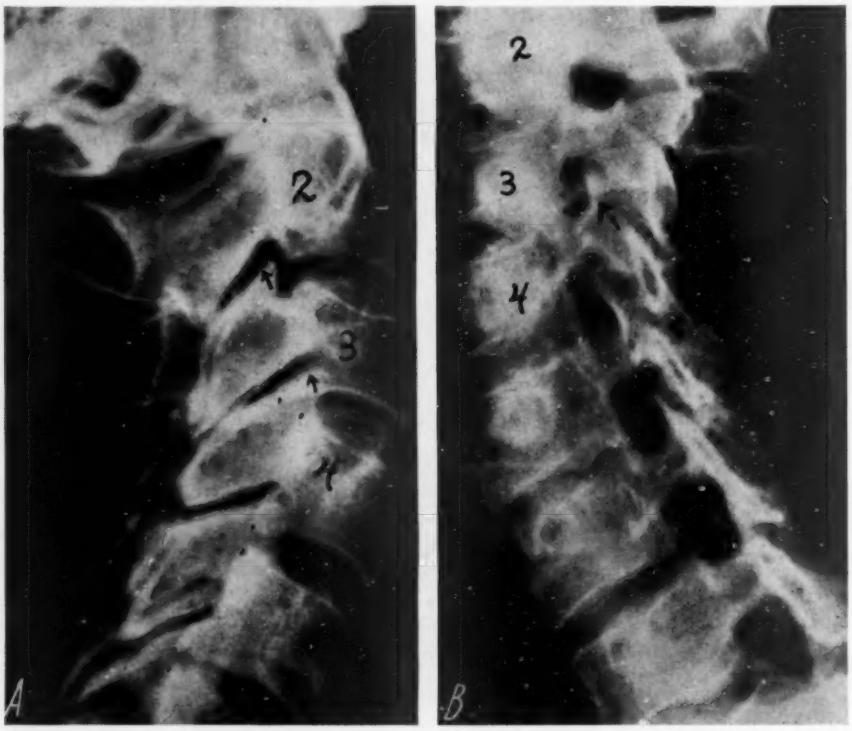


Fig. 1. *A*, preternatural mobility of third body backward on fourth from old injury. Articulation widened in front (arrows). In spite of this condition, note that normal anterior curve is retained. *B*, oblique view showing third foramen encroached upon by superior articular process of fourth (arrow).

SPONTANEOUS SUBLUXATION OF THE ATLAS

Children complaining of painful stiff neck usually of sudden onset and without trauma should be examined for this condition. It follows an inflammatory process in the nasopharyngeal region, usually in children, although Wilson has reported one patient sixty-two years old. The spontaneous forward displacement of the atlas on

the axis is thought to be due to a softening of the transverse ligament of the atlas or distention of the bursa between the odontoid process and the anterior arch of the atlas. The child may complain of painful torticollis, supporting his head with the hands. He should be carefully handled during the roentgen examination since death has resulted from careless movement of the head causing pressure upon the medulla.

On the lateral roentgenogram a space is seen between the anterior arch of the atlas and the odontoid process. The odontoid may be demineralized. The ascending ramus of the jaw is more than normal distance anterior to the spine, and the posterior arch of the atlas is well anterior to the alignment of those below (Fig. 3).

Fractured odontoid process with forward displacement presents the latter two features but there is a history of injury and the anterior surface of the odontoid is well anterior to the anterior surface of the second vertebral body. The treatment is extension and support.

Spontaneous subluxation is not to be confused with congenital torticollis. This latter is painless with sternomastoid spasm of long duration and no forward displacement of the first segment. There is rotation,

Fig. 2. *A*, traumatic subluxation of fourth cervical vertebra forward on fifth body four and one-half months after automobile accident. Note angulation of bodies, subluxation of posterior joints (arrow) and separation of neural arches at this level. There are compensating subluxations of the third posterior joints in the reverse direction to enable the upper cervical spine to assume the vertical position. Note that the tip of superior articular process of fourth is anterior to normal position. Patient complained of muscle spasm, limitation of motion, local and radicular pain. *B*, same patient two years seven months later. Fusion of fourth, fifth, and sixth bodies—acquired type—posterior joints persist. Continued limitation of neck motion, radicular pain. At end of seven years, patient has complete fusion of these bodies with absorption of disc substance. For oblique view, see Figure 7.

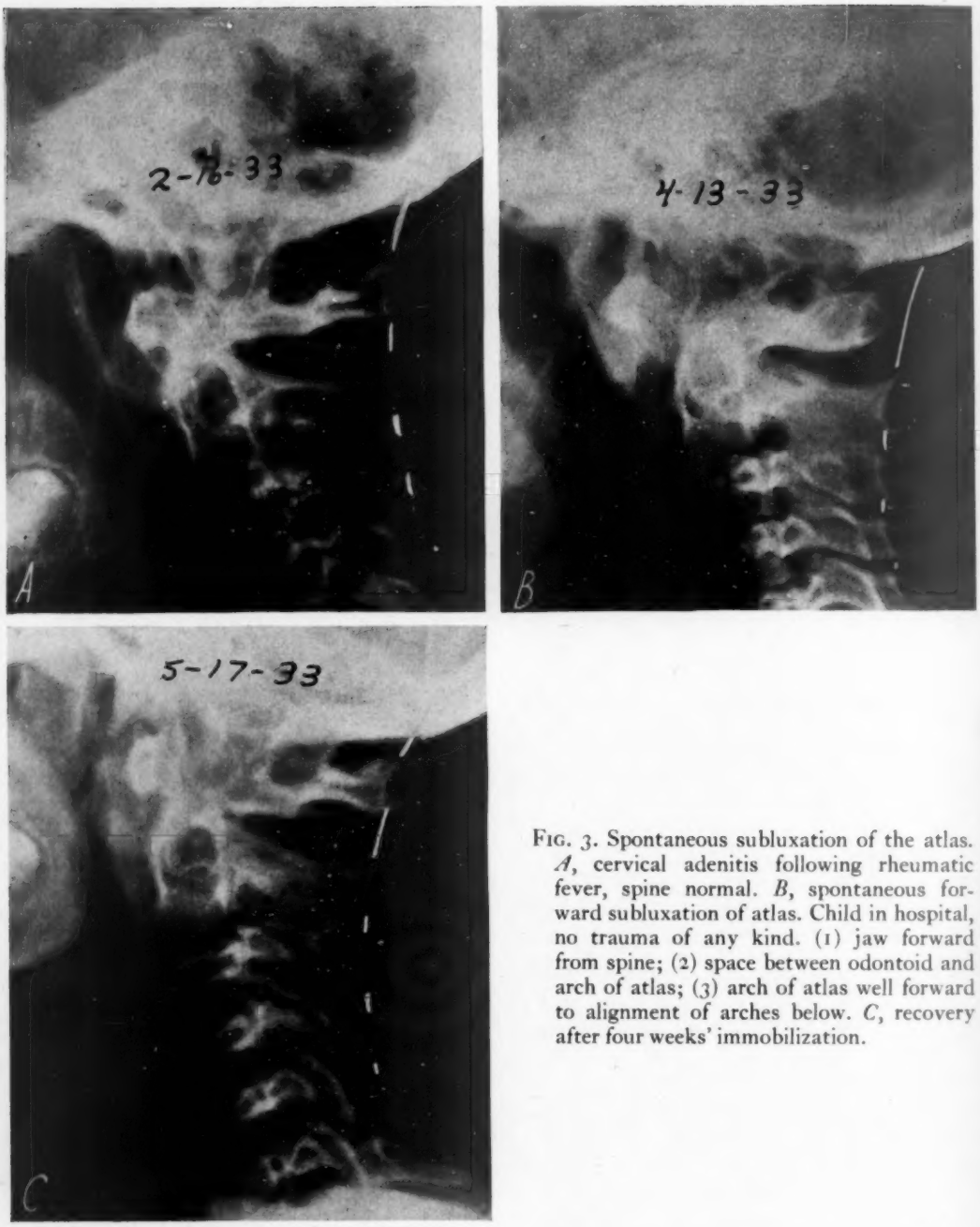


Fig. 3. Spontaneous subluxation of the atlas. *A*, cervical adenitis following rheumatic fever, spine normal. *B*, spontaneous forward subluxation of atlas. Child in hospital, no trauma of any kind. (1) jaw forward from spine; (2) space between odontoid and arch of atlas; (3) arch of atlas well forward to alignment of arches below. *C*, recovery after four weeks' immobilization.

however, of the atlas on the axis which may become straightened upon anterior flexion of the neck. The resulting list of the spine may be compensated for by one of the lateral masses of the atlas being larger than the other. Or if there is a fusion, one side of the block vertebra will be higher than the other. There is likely to be distortion in the shape of the atlanto-axial joint surfaces with the odontoid process displaced to the side against one of the lateral masses of the atlas.

ROTATION

Rotation in the upper cervical region is well visualized by stereoscopic base-vertex

axial roentgenograms if the patient is able to lie supine on a level 8 or 10 inches above the plane of the films with the neck extremely dorsoflexed and the vertex of the head resting on the film. The central ray is parallel to the plane of the face but directed at the larynx. Such a technique visualizes the relationship between the base of the skull and the upper two or three cervical bodies (Fig. 4). This also may be done in the vertical position.

In the true lateral view with the two angles of the jaw well aligned the profile of the anterior surface of the second body is seen as a straight line continuous with the odontoid process, but if there is a rotation of the second cervical, the articular surface on the side more forward appears as a triangle lying in front of the second body.

Rotation and scoliosis in the cervical region are both well shown in the stereoscopic posteroanterior "chewing" roentgenograms and are important because these patients are more liable to injury by the "whip-snap" type of accident.

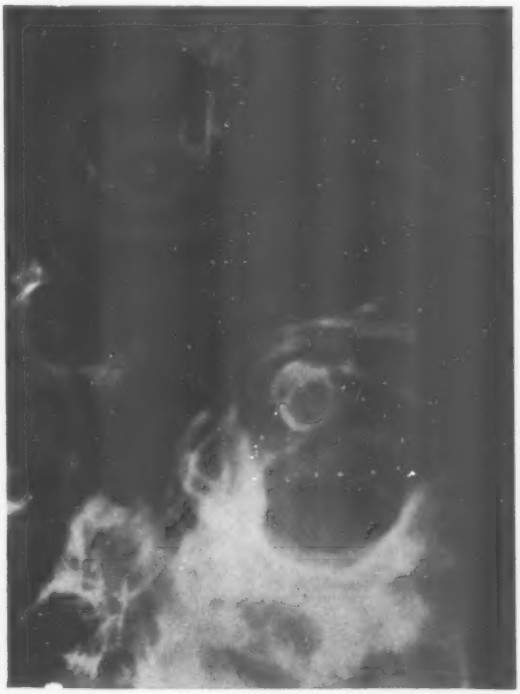


Fig. 4. Base-vertex view showing rotation of atlas on axis incidental to congenital torticollis. Body of second cervical vertebra indicated by dotted line. First cervical displaced laterally bringing odontoid against its left lateral mass.

Fig. 5. Ossification of the oblique portion of the atlanto-occipital ligament above the arch of the atlas, the so-called ponticulus posterius, arching over the foramen arcuale which gives passage to the vertebral artery and the suboccipital nerve where they pass over the upper surface of the first arch. This structure probably results from the most anterior of the three half somites from which the atlas forms early in embryological life.

Occasionally in the lateral view one observes a widening of the arch of the atlas with a foramen for the passage of the suboccipital nerve and the vertebral artery. This is the foramen arcuale arched over by the ponticulus posterius or ossified oblique portion of the atlanto-occipital ligament (Fig. 5).

FLEXION-EXTENSION STUDIES

Comparative lateral roentgenograms of the cervical spine made at the extremes of forward flexion and dorsal extension will show, in the forward position, the dorsal spinous processes widely separated, while upon dorsal extension they become closely approximated.

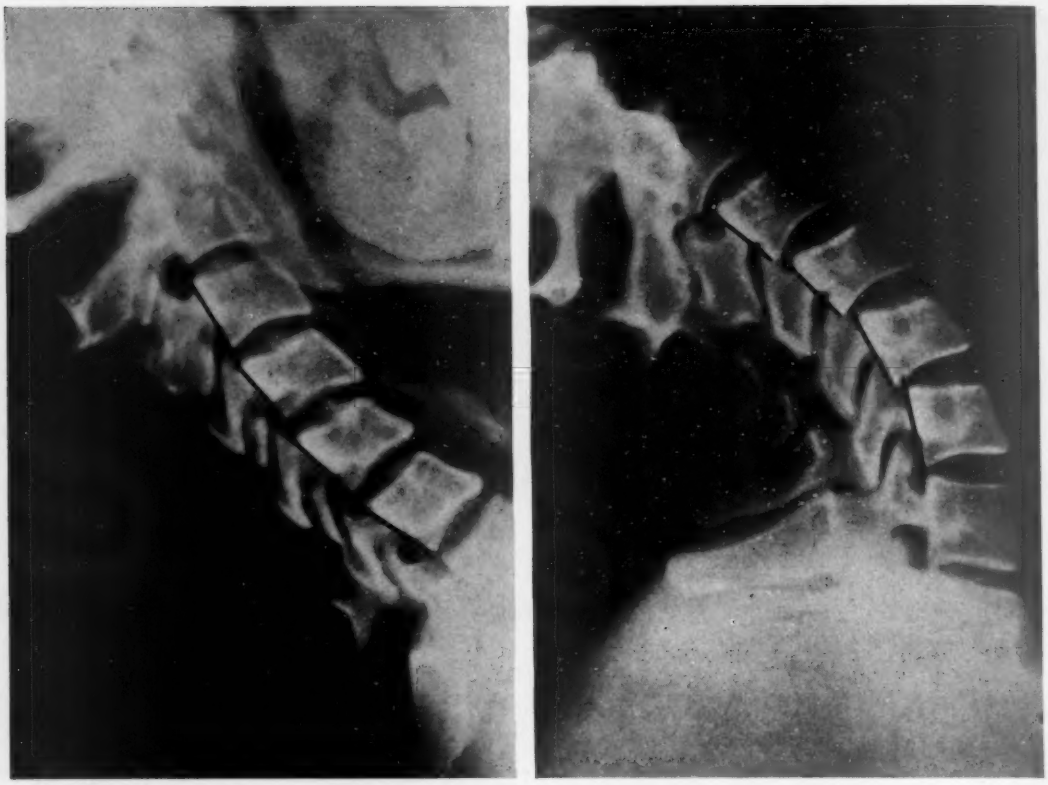


Fig. 6. Studies of the cervical spine in extremes of flexion and extension, showing how each vertebral body glides backward and forward on the one beneath it. Note movement in the posterior articulations, also the separation of spinous processes in forward bending.

Arthritis or trauma interferes with this demonstrable movement between the various cervical segments so that either from spasm or fixation the flexion-extension studies may reveal a lack of movement between various segments either at one level or involving the whole cervical spine. That is, two or more of the spinous processes do not separate upon bending forward. Upon subsequent examination it will be found that, in some cases, complete recovery of normal movement has taken place while in others the fixation seems to be permanent. By this method it is possible to furnish roentgen evidence of injury and of progress in recovery even when the roentgenogram does not show evidence of bone or joint injury.

GLIDING MOVEMENT

Examination of those cervical vertebral bodies below the second reveals the upper surface saddle shaped with the lateral margins raised above the level of the central portion. The undersurface of the body represents a section of a cylinder with its axis transverse.

The flexion-extension studies reveal not only a flexion between the bodies with separation of the spines, but also a gliding of each vertebral body backward and forward upon the one beneath it. Measurements show that the point of greatest amplitude of this gliding is about the mid-cervical region. This is the level of maximum disc degeneration noted later in life, and would seem to indicate that probably wear is a factor in producing such degenerative changes (Fig. 6, 29 and 30).

THE 45° OBLIQUE TECHNIQUE

In the lumbar and dorsal regions the intervertebral foramina open from the

lateral walls of the spinal canal. In the cervical region, however, they are directed laterally and forward about 45° to the sagittal plane and slightly downward.

The roentgenogram is best made with the patient sitting upright, spine erect, chin up, the occlusal plane of the teeth horizontal, and the shoulder of the side to be visualized against the vertical plate holder. The latter should be at such a height that the upper end of an 8 by 10 inch cassette is on a level with the patient's ear. Use a measuring triangle of thin wood with angles of 45°–90°–45° about 18 inches long on each of the two short sides. By sighting across the triangle downward from above the patient, arrange the transverse plane of the shoulders and the sagittal plane of the skull each 45° to the plane of the film. The head may be steadied by a small block between the cheek and the plate holder. The target of the tube is about 6 feet directly back of the patient. The central ray is directed toward the mid-cervical region and 10° caudad.

This technique visualizes all of the cervical foramina of that side next the film beginning with that beneath the second vertebra. There is, of course, no intervertebral foramen directly beneath the first segment.

The oblique roentgenogram can also be made with the patient lying on the Bucky table, the sagittal plane of the skull and that between the tips of the shoulders 45° to the table top. The central ray passes vertically from behind and through the atlanto-occipital joint. The patient is well

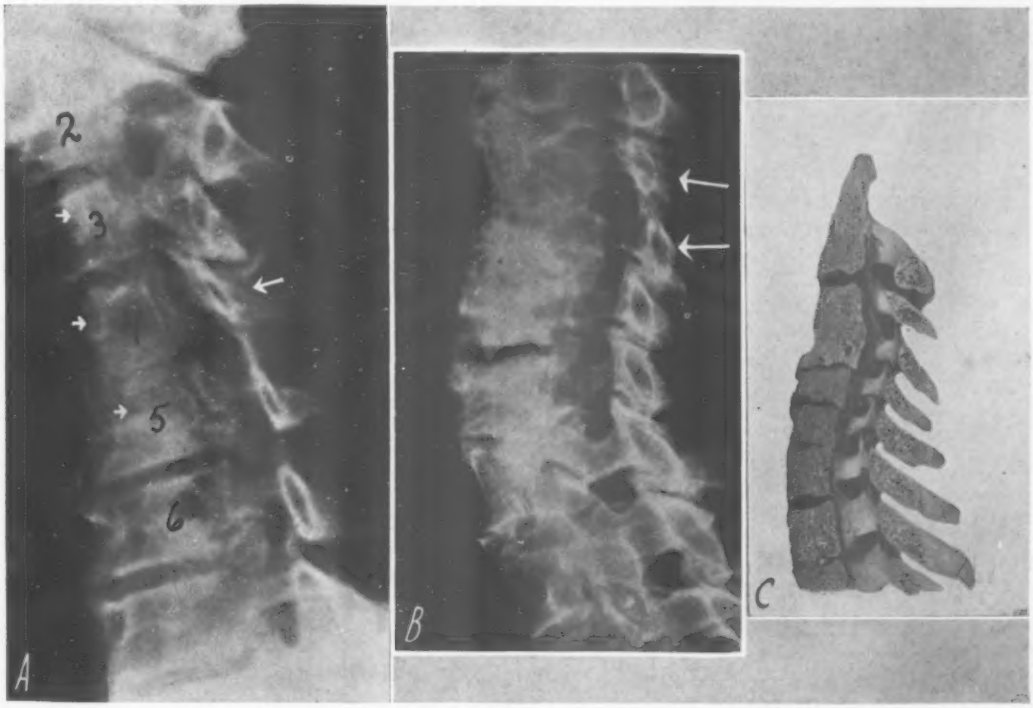


Fig. 7. *A*, oblique view of same patient as Figure 2. Malalignment of posterior arches (large arrow) by forward angulation of fourth on fifth, separation between fourth and fifth arches. Encroachment of third foramen by exostosis from arthritic posterior joint plus forward displacement of fourth superior articular process by compensatory lordosis at 3–4 level. Malalignment of pedicles on opposite side (small arrows). Patient complained of severe radicular symptoms. *B*, oblique view of specimen, *C*, old traumatic angulation. Separation of laminae (arrows) with enlargement of foramen at this level. Other foramina encroached upon by arthritic process of posterior joints and degeneration of the discs. Compare with *A*.

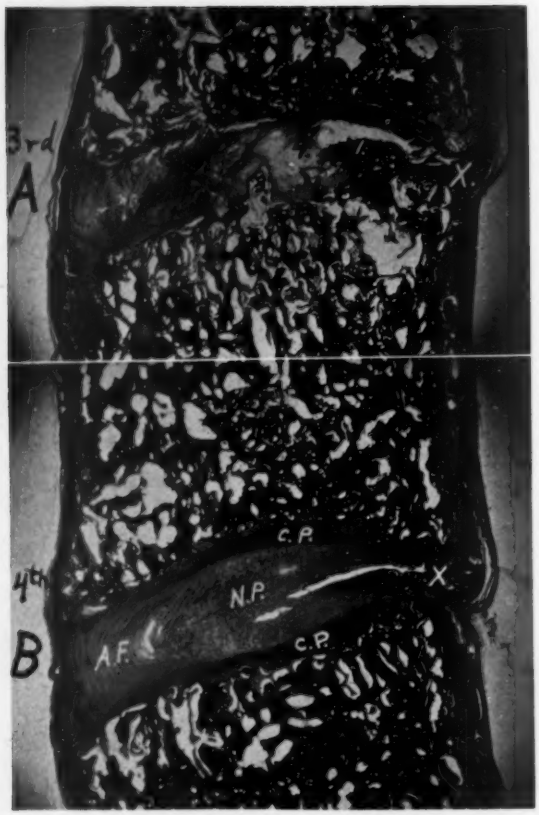


Fig. 8. Sections (×5) cut from third and fourth cervical discs. *A*, advanced disc degeneration. Cartilage plates fragmented (*1*); nucleus pulposus replaced by fibrous tissue (*2*), bony trabeculae (*3*) and new blood vessels (*4*) growing from adjacent vertebral bodies into the disc substances. Vertebral bodies nearly in contact at posterior margins of disc (*X*). *B*, normal cartilage plates (*C.P.*), nucleus pulposus (*N.P.*) and annulus fibrosus (*A.F.*), but destruction of annulus fibrosus at posterior margin of the disc (*X*). Anterior two-thirds of disc normal.

supported by sand bags and he is asked to move the jaw while the exposure is being made.

THE NORMAL OBLIQUE CERVICAL ROENTGENOGRAM

A roentgenogram of the cervical spine made according to the foregoing technique reveals the intervertebral foramina in their normal shape and position. The topmost or second cervical is oval and those below this point are shaped, as Schmorl has described, somewhat like the "sole of a shoe." The second and seventh are directed more laterally than those intervening. Each foramen is bounded above and below by a pedicle, in back by a posterior articulation and in front by vertebral bodies and the intervertebral disc.

Posterior to the foramina the laminae of the same side of the arch are seen in section, that is, their cortex in profile. Those for arches, numbers two and seven are oval and larger than the intervening third,

Fig. 9. Female patient with spondylitis deformans. Roentgenogram made in anterior flexion showing movement between occiput and atlas and between atlas and axis but none below. Thickness of discs preserved. There was no encroachment of the intervertebral foramina.

fourth, fifth and sixth laminae which are smaller and more flattened. The posterior articulations are visualized between and partially overlapped by the shadows of the laminae.

In the oblique view of the normal cervical spine, all arches, as well as the foramina, pedicles, and vertebral bodies appear in a smooth, sweeping symmetrical curve about equidistant from each other. Any malalignment in this curve or irregularity in the spacing of the sections indicates a disturbance in the structure of the articulation of the cervical units.

The arch of the first vertebra may normally appear slightly anterior to the curve of the other laminar sections. The dorsal spinous processes should be just visible at their tips behind the spine and the angle of the jaw usually crosses the second vertebra.

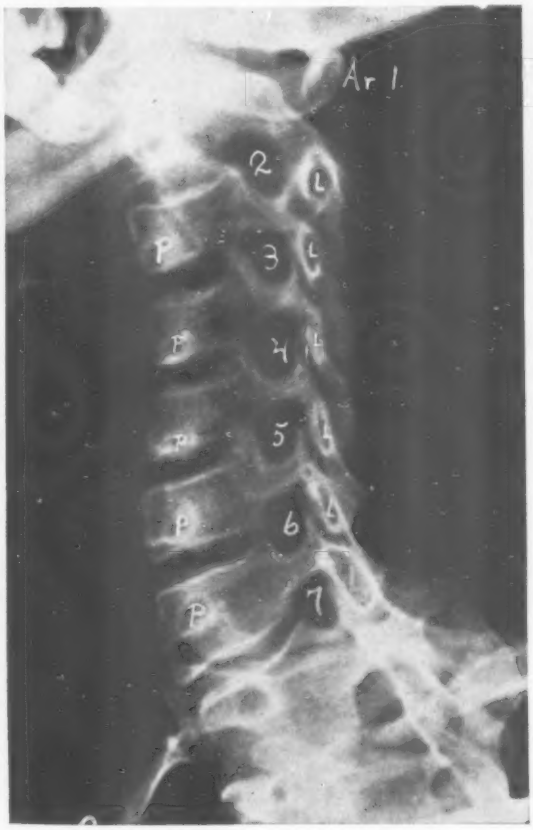


Fig. 10. Normal 45° oblique cervical spine. Note that the laminae (*L*), foramina (numbered), the bodies and the pedicles of the opposite side (*P*) are all arranged in a symmetrical curve. *Ar 1*, first cervical arch with the atlas-axis articulation in front of it.

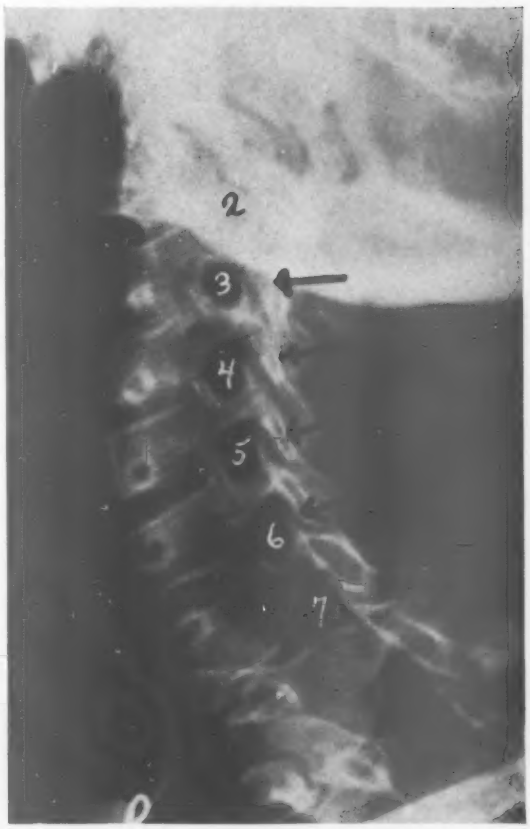


Fig. 11. Same patient as Figure 10. Roentgenogram made in extreme dorsal extension showing physiological constriction of foramina 3, 4 and 5.

The articulation between the first and second bodies, extending transversely, is seen just above the second foramen. It is not abnormal for the edges of the articular surfaces of this joint to be slightly out of alignment with each other.

The pedicles on the side opposite to the visualized foramina, that is, the side farthest from the film, appear as a curved line of small equidistant oval shadows one for each vertebral body. If correct technique has been used in making the roentgenogram, this line of pedicle shadows will intersect the shadows of the vertebral bodies near their anterior surfaces. The interpe-

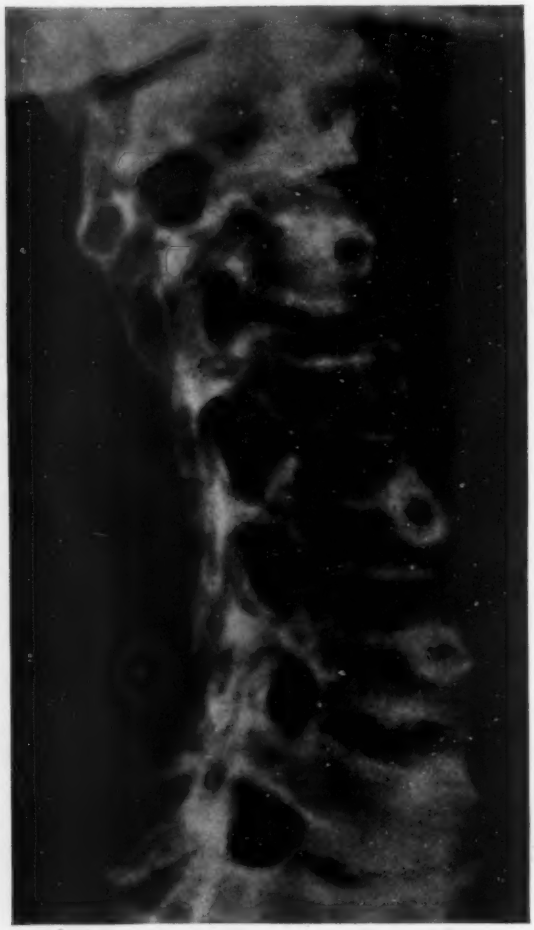


Fig. 12. Football injury—fracture of the sixth pedicle. Traumatic encroachment of third and sixth foramina.

diculate distance represents the size of the foramen. In certain cases of cervical spine disturbance, these pedicle shadows may be distorted in shape, size, spacing or alignment or in cases of advanced disc degeneration they may be obscured by demineralization and the overlying shadows of exostoses (Fig. 10).

Disc Degeneration (Geredisc)

At the apices of the spinal curves, that is, the mid-cervical, mid-dorsal and lower lumbar region, the spine is placed under its greatest functional stress. It is likewise at these levels that the earliest, and later, the most advanced, stages of disc degeneration occur—apparently as a direct result of the wear and tear of use. In the mid-cervical region this corresponds to the level of greatest amplitude of the gliding movement. At first, the changes are seen on the concave side of the curve, that is, the more compressed side of the disc. In the dorsal region this is anterior while in the cervical region the posterior portion of the disc first shows degenerative change.

This begins as a replacement of the nucleus pulposus by fibrous tissue. The cartilage plates of the disc become fragmented and loops of blood vessels grow through these openings from the vertebral bodies into the disc substance. Later the discs become thinned. Bony trabeculae may form from this fibrosis either entirely within the disc or projecting from the vertebral body into it (Fig. 8).

With thinning of the discs the margins of the vertebral bodies approach each other and bony spur formation or bridging is stimulated.

On section, two types of bridging are noted. More commonly one sees the "parrot beak" type wherein no matter how large the bridge becomes complete bony union never occurs. The two spurs are always separated by a layer of fibrous tissue extending outward from the disc. The other, solid type, appears as though molten bone had been poured from one vertebral body down across the edge of the intact disc margin to join the vertebral body below. It is very common for a separate bony fragment to develop in the margin of a disc and simulate fracture of an exostosis when no fracture has occurred.

Degeneration is not primarily the result of an infection or inflammatory process. Early disc degeneration will not show on the roentgenogram but when it has become sufficiently advanced it is seen as a thinning of the disc shadow with sclerosis of the vertebral plate, bony spur formation and bridging.

The word "geredisc," to indicate the aging process by which it develops, is a better term than "degeneration" to describe

this common condition resulting from the natural wear of life.

ARTHRITIS

The acute stage of this condition may involve even a single posterior articulation in the cervical region with limitation of motion and pain. The sharpness of the roentgen image is blurred and a well delineated joint shadow is not seen. Care must be taken to compare this joint with those above and below, bearing in mind any variation in the direction of their planes which may be present. With recovery, the normal sharpness of the roentgen image may return.

A chronic arthritis, or perhaps more properly arthrosis, may involve one or more of the posterior joints. The joint space is thinned, moth-eaten, or irregular in outline and there is sclerosis of the adjacent bony tissue. Bony spur formation about the joint margins may project backward, laterally or forward into the foramen. It may be possible to demonstrate localized fixation of movement by the flexion-extension studies.

SPONDYLITIS DEFORMANS

In the late Marie-Strümpell type of spondylosis the anterior longitudinal ligament in the neck is seen as a delicately calcified structure, not the massive heavy bony bridging noted in the lower spine. Both the discs and the vertebral bodies preserve their normal cephalocaudad diameters. The posterior articulations are ankylosed and the normal size and shape of the intervertebral foramina are preserved. It is particularly interesting to note, however, upon study of the flexion-extension roentgenograms, that motion is preserved in the atlanto-occipital and the atlanto-axial joints

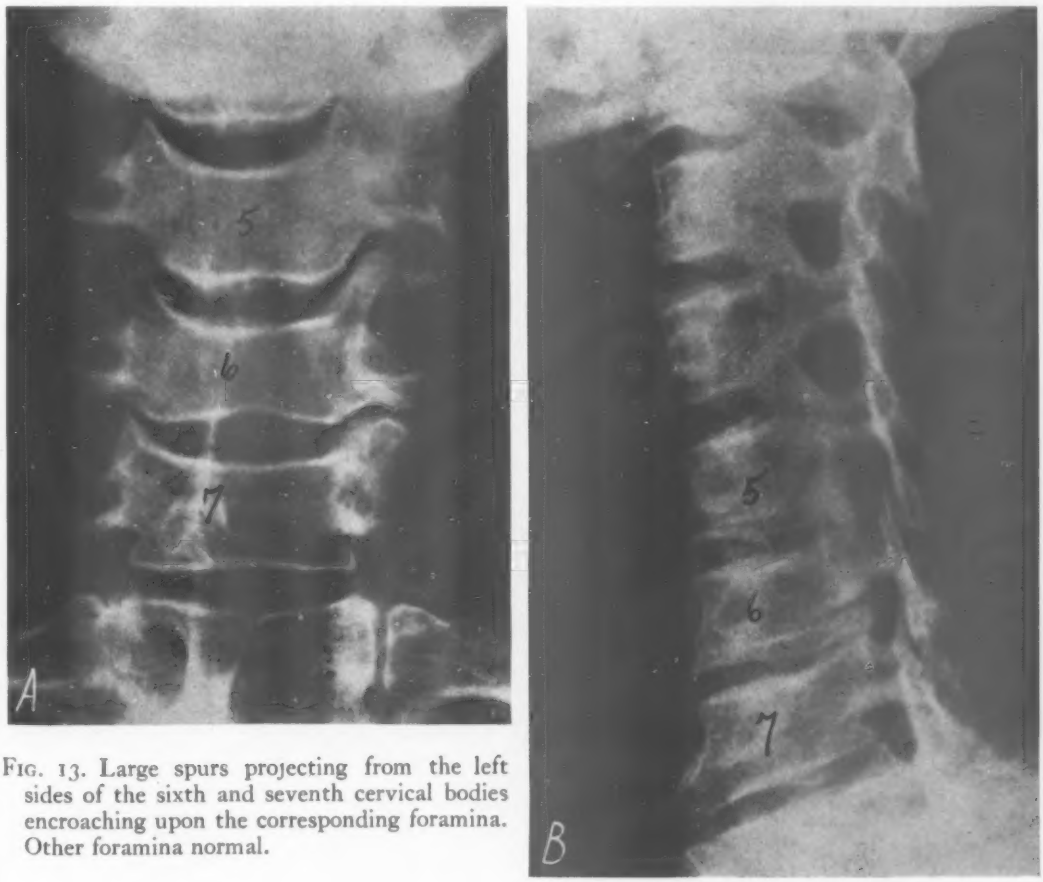


Fig. 13. Large spurs projecting from the left sides of the sixth and seventh cervical bodies encroaching upon the corresponding foramina. Other foramina normal.

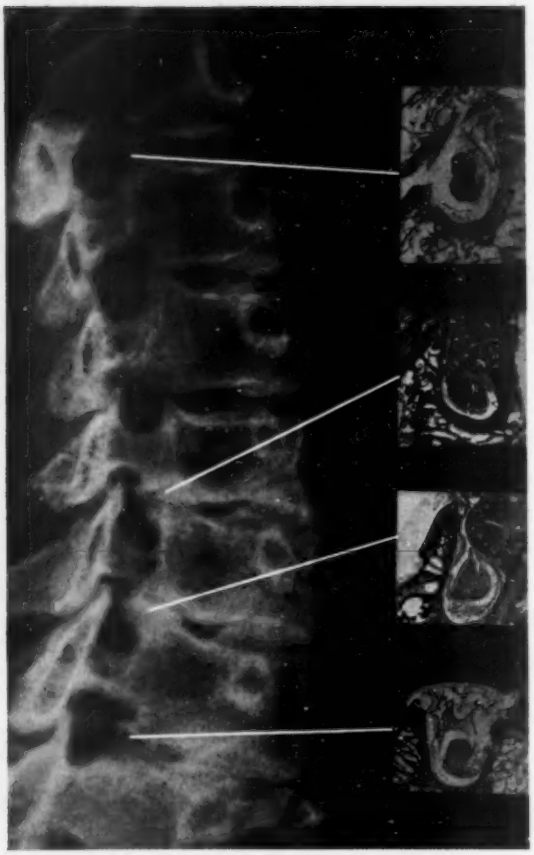


Fig. 14. Roentgenogram of a cadaver specimen and sections cut from the foramina as indicated by the white lines. Top and bottom foramina normal showing the sectioned nerve root occupying about one-fifth the foramen diameter. The two middle foramina are encroached upon by bony exostoses from the vertebral discs.

where no intervertebral discs participate. Since diarthrodial joints away from the spine are little affected, the question arises as to whether or not this disease may not primarily involve the discs rather than the posterior articulations with secondary ankylosis of the latter (Fig. 9). Spontaneous forward subluxation of the atlas on the axis may take place in this condition.

FORAMEN ENCROACHMENT

There are at least six ways in which intervertebral foramen encroachment may occur.

The first is physiological. The foramen is constricted by dorsal extension (Fig. 11) or by a permanent lordosis increasing the normal cervical curve and causing the superior articular processes to extend into the upper portion of the foramen. Dorsal kyphosis exaggerates the cervical curve. Rotation or flexion toward the foramen also decreases its diameter and the opposite movements enlarge the foramen diameter.

Trauma, as in fracture (Fig. 12), or rarely posterior displacement of a cervical body (Fig. 1) may constrict a foramen. Most displacements, however, are forward and these tend to enlarge the foramen.

As stated above, an arthritic process involving the posterior joint with bony exostoses projecting forward may cause foramen encroachment just as the bony spurs from the margin of a geredisc in front may project backward into the foramen (Fig. 7*B*). The spurs are much more extensive than they appear on the roentgenogram (Fig. 13).

Fig. 15. Increased anteroposterior diameter of cervical canal by pressure of neurofibroma. Cortex distortion at arrow.

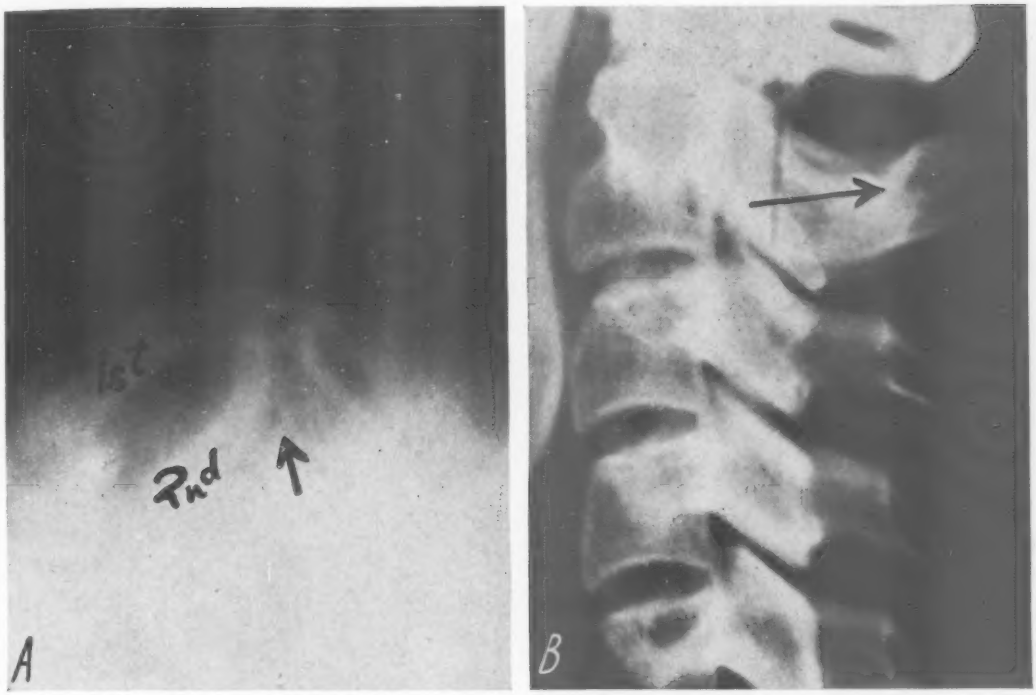


Fig. 16. *A*, first and second cervical arches seen through the foramen magnum. There is incomplete fusion of the second arch (arrow). *B*, lateral view, the cortex of anterior surfaces of arches (posterior wall of spinal canal) is normal for the 1st, 3rd, 4th, and 5th but is broken (saw-tooth shaped) for the 2nd arch, denoting incomplete fusion in the lateral view (arrow).

As I have previously described in connection with studies of the lumbar spine, thinning of the intervertebral disc from degeneration allows the bodies to come more closely together, producing not only encroachment of the foramen in a cephalocaudad direction but also a certain degree of posterior joint subluxation. The inclination of the planes of the posterior articulations in the cervical region accordingly induces wedging of the superior articular processes forward into the upper portion of the foramina. This joint derangement may be a partial factor in causing the local pain, muscle spasm, and limitation of motion of which these patients complain.

Fibrous hyperplasia of the posterior joint capsule is a factor producing constriction of the foramen in some cases. Also in many of the sections studied intervertebral disc substance is clearly demonstrated bulging backward into the foramen.

Normally the nerve occupies about one-fifth to one-fourth the diameter of the cervical foramina; the remainder of the space is taken up by lymphatics, blood vessels, areolar and fatty tissue.

Bony or fibrous tissue encroachment may reduce the size of the foramen to one-fourth normal (Fig. 14), crowding the nerve into the lower portion of the opening or it may become flattened in a ribbon-like manner or even completely destroyed. In examining cadaver material the nerve can usually be separated within the foramen by blunt dissection. In other cases it appears to be adherent and surrounded by fibrosis.

Patients with foramen encroachment not only complain of local pain, tenderness, muscle spasm, and limitation of neck motion, but also frequently suffer from radiculitis. In the cervical region this condition is characterized by pain referred to the shoulder, arm or hand, corresponding in distribution to that of the involved nerve root and is frequently aggravated by cough-

ing or sneezing—the so-called Dejerine sign. Not all patients, however, suffering from radiculitis exhibit foramen encroachment on the roentgenogram.

PROFILE OF THE VERTEBRAL CORTEX

In the anteroposterior, lateral, and oblique views, the cortex of bony structures when lying parallel to the ray appears as a dense white shadow—the profile of the cortex. A complete evaluation of these shadows adds much to the interpretation of the roentgenogram in three dimensions.

A familiar example is the circular shadows of the pedicles as visualized on the anteroposterior views of the dorsal and lumbar regions and the 45° oblique studies of the cervical region. It should be borne in mind that the interpediculate distance corresponds to the cephalocaudad diameter of the foramen. Demonstration of a constricted foramen is easy even in this view when it is compared with the greater interpediculate diameter of the normal foramina. In tumors of the cord one is accustomed to seek some evidence of distortion of the

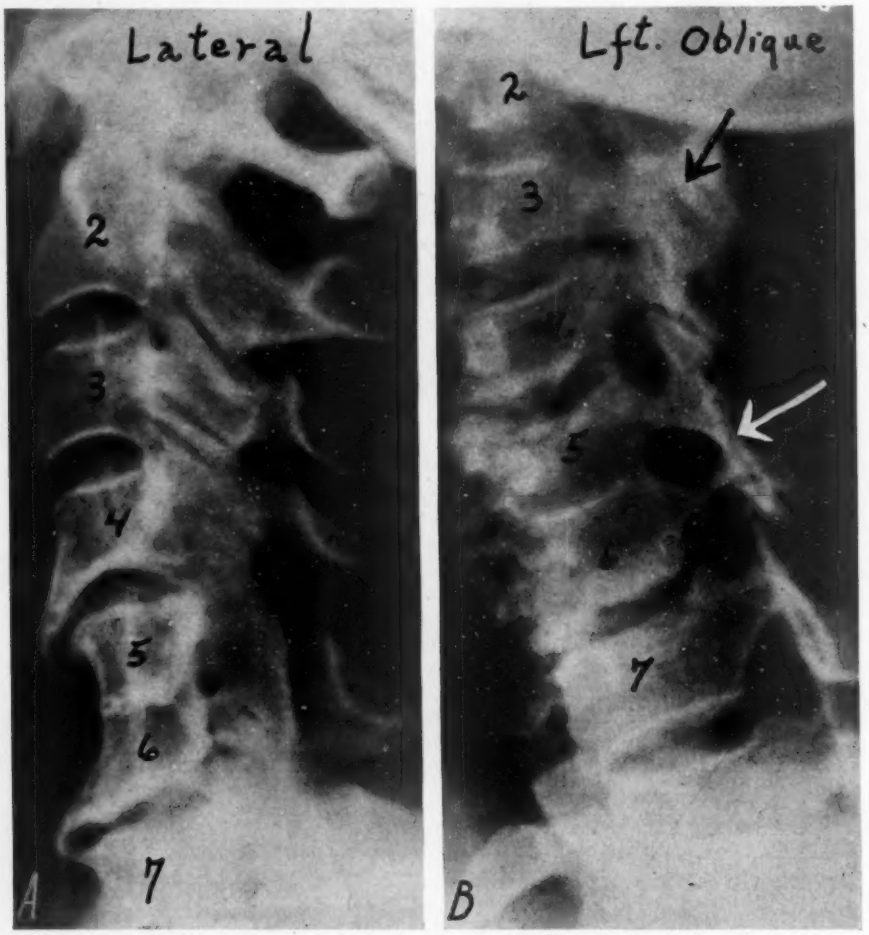


Fig. 17. Congenital fusion of fifth and sixth bodies, arches and posterior joints with one spinous process. Fifth foramen not constricted (white arrow). Increased stress on fourth and sixth discs with degeneration and spur formation but little foramen encroachment. Advanced arthritis (black arrow) of third left posterior articulation with bony encroachment of third foramen. Patient complained of local and radicular pain of many years' duration.

cortex on the medial side of the pedicle or the posterior surface of the vertebral body (Fig. 15).

In the oblique view of the normal cervical spine, the separate laminae appear as a series of dense, somewhat flattened oval shadows arranged in a symmetrical curve. If there is an angulation of the spine the distance between the oval shadows at the level of angulation is increased, the symmetry of the curve is lost at this point and those laminae above, instead of continuing the curve, project forward at a different angle (Fig. 7, *A* and *B*).

Not infrequently a fusion of adjacent laminae is encountered. In this case two or more of the smaller normal size oval shadows will be replaced by a large one—the profile of the cortex of the fused laminar mass (Fig. 23).

With demineralization from disuse or other causes, the cortex profile is proportionally not well visualized.

In the lateral view the dorsal surface of

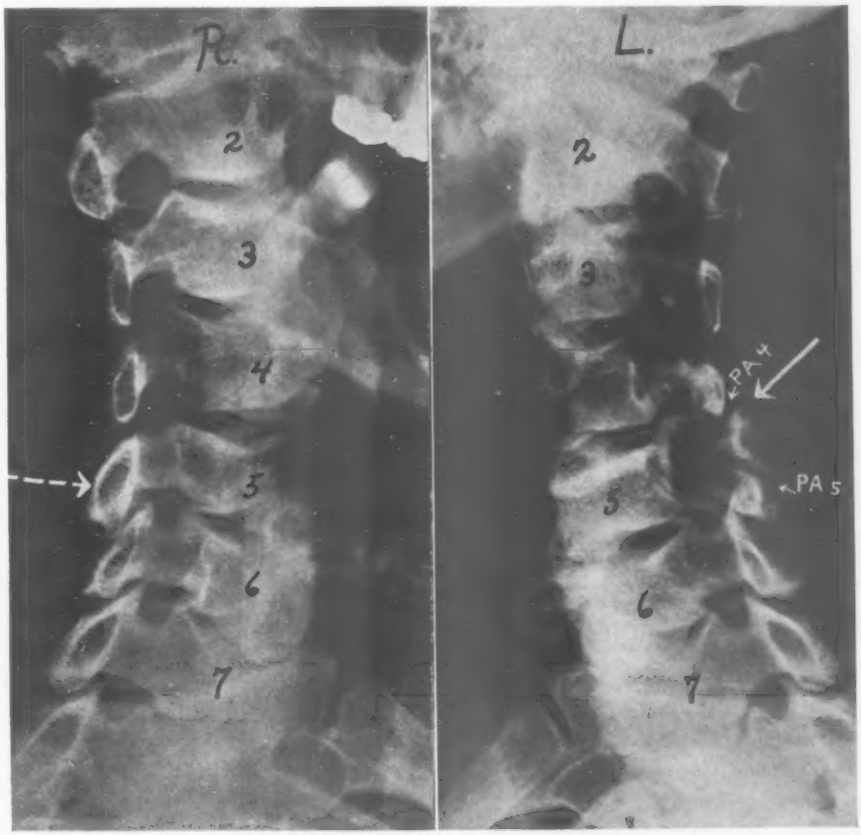


FIG. 18. Congenital absence of the fifth left pedicle. All pedicles on the right side are normal. On the left the fourth is small and the fifth is absent. There is a large common foramen for the left fourth and fifth roots. The shadow crossing this large foramen is the fifth transverse process. The unbalanced stress is partly borne by the fifth neural arch which has become more dense than normal (dotted arrow) and partly by a bony process projecting from the fifth body laterally and upward to the fourth. There is a break in the normal symmetrical curve of the posterior arches on the left side (white arrow). The left 4–5 posterior articulation (*PA4*) is deficient, the lower element being posterior to the upper and the 5–6 articulation (*PA5*) is above and posterior to its normal position. The triangular bone between *PA4* and *PA5* is the fifth neural arch. No history of injury in early life.

Fig. 19. Klippel-Feil syndrome. J. H., aged eight years, fusion second, third, and fourth bodies with their posterior articulations and arches, one spinous process. Fifth and sixth vertebrae separate.

the spinal canal, that is the anterior surface of the arch, appears as a very dense narrow white line. In case there is a spina bifida present it can be diagnosed from the lateral view since the dense white line above mentioned becomes irregular, broken, or disappears entirely (Fig. 16).

Further applications in a study of the

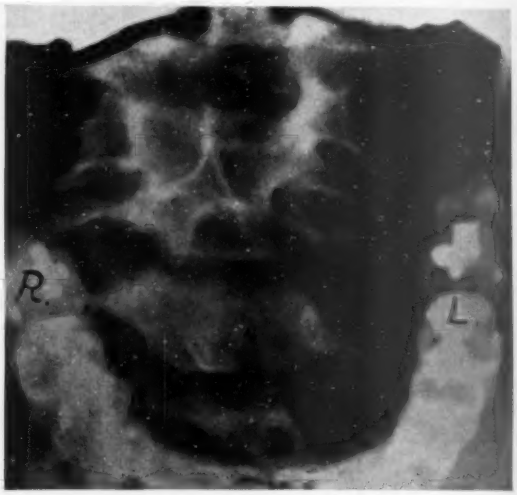


Fig. 21. J. H. Block vertebra higher on left side to compensate for tilt of neck to left caused by high right shoulder.

profile of the cortex will readily present themselves.

CONGENITAL CONDITIONS

One of the most common congenital conditions occurring at any level below the first segment is a fusion of two or more adjacent cervical vertebral bodies normally separated by discs. The disc is absent or indicated by a line of increased density. The arches may be separate with fusion of the

Fig. 20. J. H., aged twenty-two years. More complete fusion after fourteen year interval. Normal movement between occiput and atlas and between atlas and axis.

posterior joints or they may be united into one bony mass with a single large spinous process.

The bony mass is likely to be higher on one side than on the other if necessary to compensate for a lateral tilt to the cervical spine (Fig. 21). The foramina at the site of congenital fusion are always smooth and round or oval while in cases of acquired fusion resulting either from injury or from degeneration of the disc there is usually a distortion in the shape of the foramina.

This condition is easily differentiated from spondylosis deformans where union of vertebral bodies occurs by bridging of the persistent disc and ankylosis of the posterior joints (Fig. 8).

Functionally this condition forms a point of non-movement in the otherwise symmetrical flexion of the neck, placing additional stress upon the adjacent movable joints and favoring their earlier degeneration (Fig. 17).

Fig. 22. J. H. Fusion of lower cervical and upper dorsal elements with scoliosis and spina bifida (dotted line).

Fig. 23. J. H. Right oblique view showing smooth round foramina of fused elements (black arrows)—foramina at movable level (dotted black arrow). Note difference in shape of normal foramina from those with congenital fusion. Profile of cortex of fused laminae (white arrows), the lower one incorporating at least four segments. White dotted arrow indicates foramen for the vertebral artery.

Certain structures, such as a pedicle or a posterior articulation, may be absent or deficient (Fig. 18).

KLIPPEL-FEIL SYNDROME

This more advanced congenital condition arising early in intrauterine life is caused by the fusion of various cervical segments. It

Fig. 24. C. C. Atlanto-occipital fusion in anterior flexion, no movement between occiput and atlas or between second and third fused vertebrae. Movement below this normal.

is characterized by short neck, low hair line, limited but painless movements of the neck, and rounded back. The patient may have prominent trapezius muscles, the "webbed" neck or pterygium colli. The scapulae may be raised (Sprengel's deformity) and the nipples low. Various other findings sometimes present are: depression in the midline posteriorly, torticollis, mirror writing, anterior or posterior spina bifida, scoliosis, and cervical ribs. Study of the profile of the vertebral cortex is instructive.

The fused elements unite into a solid block often with a single large spinous process, neural arch, and vertebral body but no posterior articulations. The intervertebral foramina persist but are smaller than normal and smooth and round or oval in outline. There is one for each of the segments making up the block and each is a complete bony ring unbroken by disc or posterior articulation. There may be one or more normal cervical segments, hemivertebrae, cervical ribs or an atlanto-occipital fusion (Fig. 19–23).

ATLANTO-OCCIPITAL FUSION

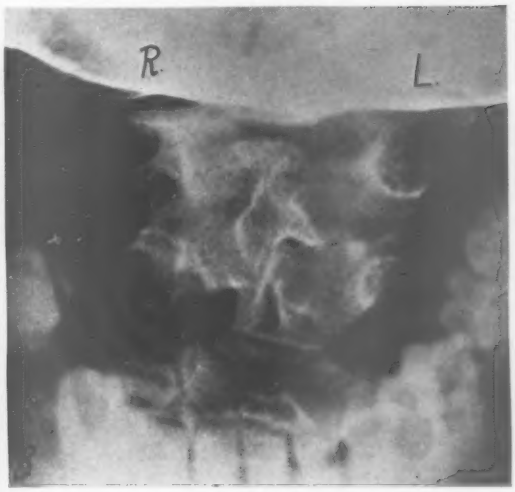
The occiput is said to represent a fusion of at least three cervical segments and, since any level of the spine may at times assume the characteristics of that level immediately above or below it, one of these segments may partly assume the vertebral form, or a complete or partial fusion of the atlas and occiput may take place. On one of the specimens in the Warren Museum at Boston, it is possible to clearly differentiate on the inside of the skull the outlines of the atlas forming a part of the occipital bone.

The ring of the atlas may or may not be incomplete posteriorly. It may be fused to the occiput on one or both sides. Flexion-extension studies will show that it does not separate from the base of the skull upon extreme forward flexion. Fusion of two or more cervical segments is likely to be present. Flattening of this area is spoken of as a platybasia (Fig. 24–26).

BASILAR IMPRESSION–(INVAGINATION)–PLATYBASIA

At least two distinct types of this condition can be differentiated. First, the congenital type with atlanto-occipital fusion, flattening of the occipital bone, distortion in the shape of the foramen magnum and displacement of the odontoid process upward into this structure decreasing its anteroposterior diameter.

The acquired type is secondary to a softening of the base of the skull as in Paget's disease, osteomalacia, or hyperparathyroidism. The skull is invaginated by the cervical spine like a thumb pressing against a soft rubber ball, thrusting the base upward into the posterior fossa. In this type, the



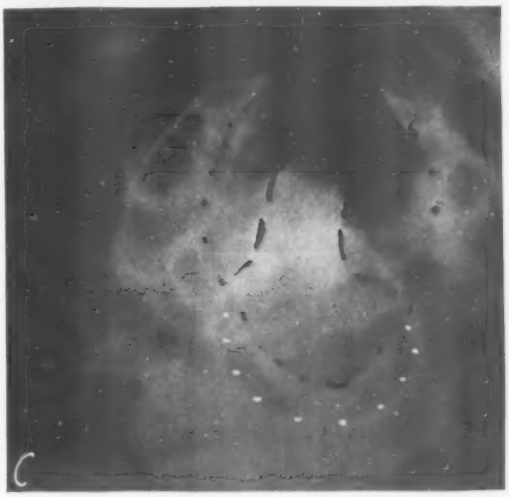


FIG. 25. Patient C. C. *A*, fusion of lateral masses of atlas with base of skull (arrows). *B*, block vertebra, 2 and 3, higher on left side to compensate for tilt of patient's cervical spine. *C*, anteroposterior view through foramen magnum (black dotted line) showing slight asymmetry of odontoid process. Arch of second cervical vertebra shown by white dotted line.

basilar portion of the skull is convex upward showing as a reverse curve. The foramen magnum may be as high as the petrous pyramids and funnel shaped, but it is not distorted in outline and the odontoid is anterior to it. The base may develop a recess to accommodate the atlas but the latter does not fuse with the occiput. Flexion-extension studies reveal movement between the base of the skull and the atlas.

Common to both types is the high position of the first cervical segment above the line from the hard palate to the posterior

FIG. 26. C. C. Oblique view showing normal foramina in a case of congenital type of platybasia. Second and third bodies fused.

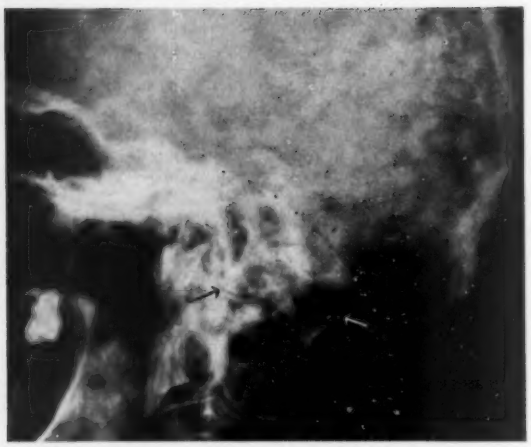


Fig. 27. Basilar impression, invagination of the base indicated by dotted line convex upward instead of downward. Notch in base to accommodate first arch (white arrow), atlanto-occipital joint movable (black arrow). First segment appears a' ove Chamberlain line. This is a case of acquired platybasia due to softening of the base incidental to Paget's disease.

margin of the foramen magnum described by Chamberlain. The petrous pyramids are raised above their normal position and distorted in shape. The clivus is nearly on a plane with the floor of the anterior fossa. The neck is short, with lessened movement of the head which may be carried at an angle. There is likely to be exaggeration of the normal anterior cervical curve in which case the foramina will be smaller than normal.

The resulting compression of the cord or cranial nerves may simulate multiple sclerosis, syringomyelia, progressive spastic paralysis, or some other neurological condition. Compression of the cerebellum may force a part of its substance to herniate downward into the cervical canal, the so-called Arnold-Chiari malformation. Authorities agree that operation is indicated in certain cases, and if undertaken, the dura must always be opened (Fig. 27 and 28).

OCCIPITAL VERTEBRA

This condition results from incomplete assimilation of the most posterior of the three scleromeres which form the base of the skull. That is, the area about the foramen magnum assumes certain features re-

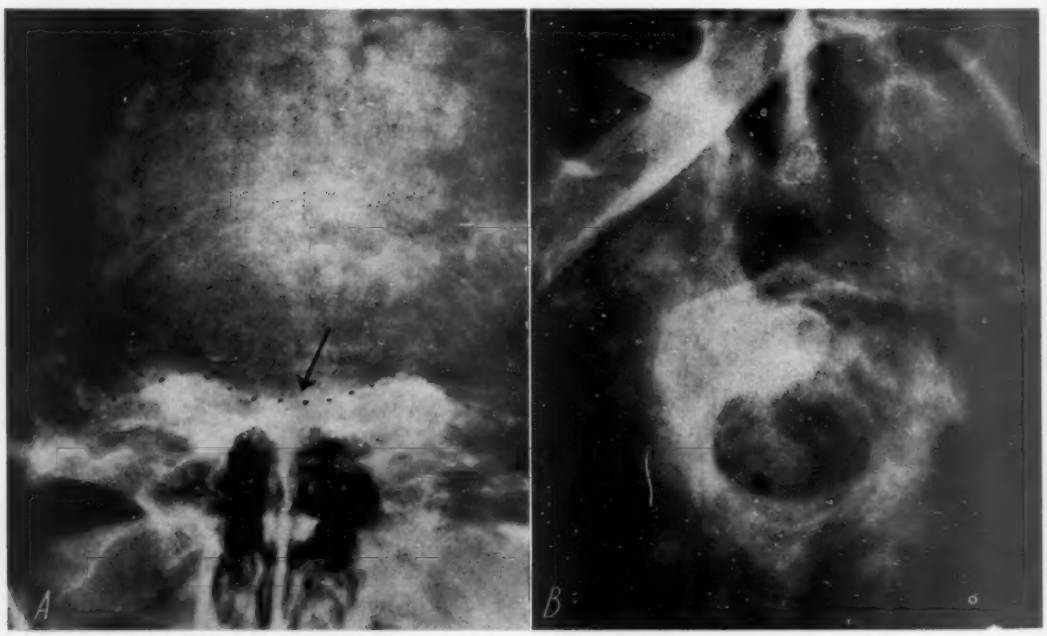


Fig. 28. *A*, anteroposterior view showing base, convex upward (dotted line) with funnel-like crater of foramen magnum in the center (arrow). *B*, symmetrical foramen magnum with odontoid anterior to it, no foramen encroachment.

sembling a vertebral segment. These are: (1) A hypochordal arch, partially or completely fused to the anterior margin of the foramen magnum. Rarely this bears an articular surface for the third condyle (see below). (2) A partial or complete neural arch outlined about the dorsal surface of the foramen. (3) Transverse processes may or may not be present, more or less fused to the base of the skull. If present they do not bear a foramen for the vertebral artery. (4) These masses, bearing the condyles, may or may not encroach upon the foramen distorting its shape. (5) The condyles resemble those of the normal subject. (6) The so-called third condyle may be present in the anterior portion of the foramen. This is a separate ossicle developed from the notochord in the terminal ligament of the odontoid and may embryologically in the normal subject form the tip of that structure. Analogous to the relationship between the atlas and the dens the third condyle corresponds to the body of the occipital vertebra with the hypochordal arch in front and the neural arch behind. Occipital vertebra is to be differentiated from atlanto-occipital fusion.

Fig. 29. Posterior extension. Note ledge of bone projecting downward and forward from occiput. The print is too light to show the shortened odontoid.

Fig. 30. Anterior flexion. Comparing with Figure 28, note movement between atlas and occiput. These flexion-extension studies, Figures 28 and 29, illustrate: (*a*) the normal gliding movement of the cervical bodies backward and forward upon each other, and (*b*) the approximation and separation of the spinous processes.

An eleven year old female suffering from occipital vertebra showed the following neurological symptoms:

Temperature and tactile perception were normal on the right side of the body. On the left side, however, there was hypesthesia to tactile and pain stimuli, and heat perception was lost while cold was interpreted as a painful sensation of heat. Tendon reflexes were exaggerated on the right side and normal on the left. Abdominal reflexes were present on the right and absent on the left. There was a strong Babinski reflex and some disturbance of coordination.

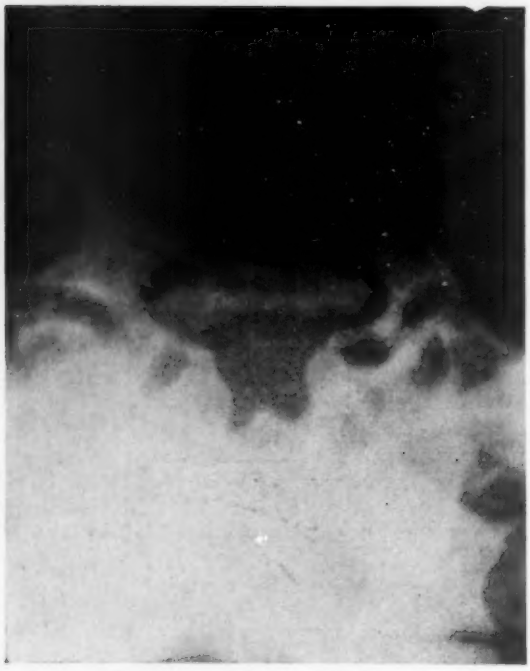


Fig. 31. Posteroanterior view of foramen magnum, shaped like a bicycle seat. The posterior, wider portion above crossed by the arch of the atlas and the anterior portion below encroached from the sides by masses of bone. The tip of the third condyle is just visible at the bottom of the narrowed anterior portion of the foramen.

In this case the roentgenograms showed:

1. A normal atlas.

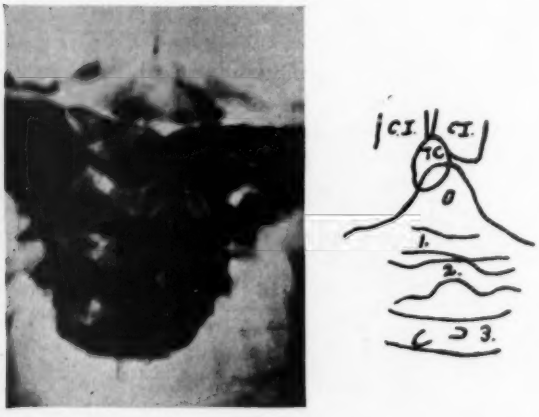


Fig. 32. Showing the "third condyle"—ossiculum terminale; anteroposterior view through the mouth: *CI*, two upper central incisor teeth; *TC*, a completely separate ossicle the so-called "third condyle"; *O* is the short stubbed odontoid process separate from the ossicle; *1*, *2*, and *3* indicate the respective cervical arches.

2. A broad, short odontoid process.

3. The posterior margin of the foramen magnum was thinned and below normal level. At operation this was found to bear, somewhat laterally, 2 cornua—the rudimentary, incomplete neural arch.

4. The outline of the foramen magnum seen above the level of the atlas was shaped like a bicycle seat. This was caused by two bony masses projecting from the sides of the foramen and encroaching upon its anterior portion.

5. Within this narrowed portion was a distinct oval-shaped ossicle entirely separate from the odontoid.

The importance of this congenital condition and its place with the platybasias in surgical treatment is shown by the operative finding in this case of a constriction of the dura at the level of the foramen magnum (Fig. 29–32).

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Acknowledgment is made of the assistance in this study by the Departments of Anatomy and Pathology of the Syracuse University College of Medicine.

REFERENCES

1. Bardeen, C. R. Development of thoracic vertebrae in man. *Am. J. Anat.*, 1905, *4*, 163–174.
2. Camp, J. D. Significance of osseous changes in roentgenographic diagnosis of tumors of spinal cord and associated soft tissues. *Radiology*, 1934, *22*, 295–303.
3. Chamberlain, W. E. Basilar impression (platybasia). *Yale J. Biol. & Med.*, 1939, *11*, 487–496.
4. Chesterman, J. T. Spontaneous subluxation of atlanto-axial joint. *Lancet*, 1936, *1*, 539.
5. Editorial. Basilar impression (platybasia). Am. J. Roentgenol. & Rad. Therapy, 1939, *42*, 443–444.
6. Gladstone, R. J., and Ericksen-Powell, W. Manifestation of occipital vertebra and fusion of atlas with occipital bone. *J. Anat. & Physiol.*, 1914–1915, *49*, 190–209.
7. Hadley, H. G. Klippel-Feil syndrome. *Virginia M. Monthly*, 1940, *67*, 421–424.
8. Hadley, L. A. Apophyseal subluxation; disturbances in and about intervertebral foramen causing back pain. *J. Bone & Joint Surg.*, 1936, *18*, 428–433.
9. Jackson, R. H. Simple uncomplicated rotary dislocation of atlas. *Surg., Gynec. & Obst.*, 1927, *45*, 156–164.

10. Jones, R. W. Spontaneous subluxation of atlanto-axial joint. *Brit. J. Surg.*, 1934, *16*, 30.
11. Langworthy, M. Dislocations of cervical vertebrae; report of 30 cases. *J. Am. M. Ass.*, 1930, *94*, 86–89.
12. List, C. F. Neurological syndromes associated with developmental anomalies of occiput, atlas and axis. *Univ. Hosp. Bull., Ann Arbor*, 1939, *5*, 57.
13. List, C. F. Neurologic syndromes accompanying developmental anomalies of occipital bone, atlas and axis. *Arch. Neurol. & Psychiat.*, 1941, *45*, 577–616.
14. Oppenheimer, A., and Turner, E. L. Discogenetic disease of cervical spine with segmental neuritis. Am. J. Roentgenol. & Rad. Therapy, 1937, *37*, 484–493.
15. Peyton, W. T., and Peterson, H. O. Congenital deformities in region of foramen magnum; basilar impression. *Radiology*, 1942, *38*, 131–144.
16. Rechtman, A. M., and Horwitz, M. T. Congenital synostosis of cervicothoracic vertebrae (Klippel-Feil syndrome). Am. J. Roentgenol. & Rad. Therapy, 1940, *43*, 66–73.
17. Schmorl, Georg. Die gesunde und kranke Wirbelsäule im Röntgenbild. Georg Thieme, Leipzig, 1932.
18. Schüller, A. Diagnosis of "basilar impression." *Radiology*, 1940, *34*, 214–216.
19. Turner, E. L., and Oppenheimer, A. A common lesion of cervical spine responsible for segmental neuritis. *Ann. Int. Med.*, 1936, *10*, 427–440.
20. Willard, DeF. P., and Nicholson, J. T. Klippel-Feil syndrome. *Ann. Surg.*, 1934, *99*, 561–567.
21. Wilson, M. J., Michele, A. A., and Jacobson, E. W. Spontaneous dislocation of atlanto-axial articulation, including report of case with paraplegia. *J. Bone & Joint Surg.*, 1940, *22*, 698–707.

THE EFFECT OF INCREASED INTRASPINAL PRESSURE ON THE MOVEMENT OF IODIZED OIL WITHIN THE SPINAL CANAL*

By BERNARD S. EPSTEIN, M.D.
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DURING roentgenoscopy in the course of iodized oil myelography definite upward movement of the column of oil was observed when the patient coughed. He was asked to cough again and the observation was confirmed. From that starting point 20 consecutive patients who were examined roentgenoscopically as part of their myelographic studies were checked for the effect on the oil column of forced respiration, increased intra-abdominal pressure, liver pressure and coughing.

All the patients had been referred for oil myelography as part of the investigation for herniated nucleus pulposus. The roentgen examinations were made on a motor driven tilt table equipped for spot film roentgenography. Three cubic centimeters of pantopaque* were injected intraspinally, affording a column of oil ample for diagnostic purposes. Lipiodol was used in 2 patients with identical results. The roentgenograms were made with the patient face

* Pantopaque is ethyl iodophenylundecylate, prepared and distributed by the Department of Radiology, School of Medicine and Dentistry of the University of Rochester, Rochester, N. Y. Supply limited by Federal law to investigational use only, and supplied to Dr. L. M. Davidoff through the courtesy of Dr. Stafford Warren.

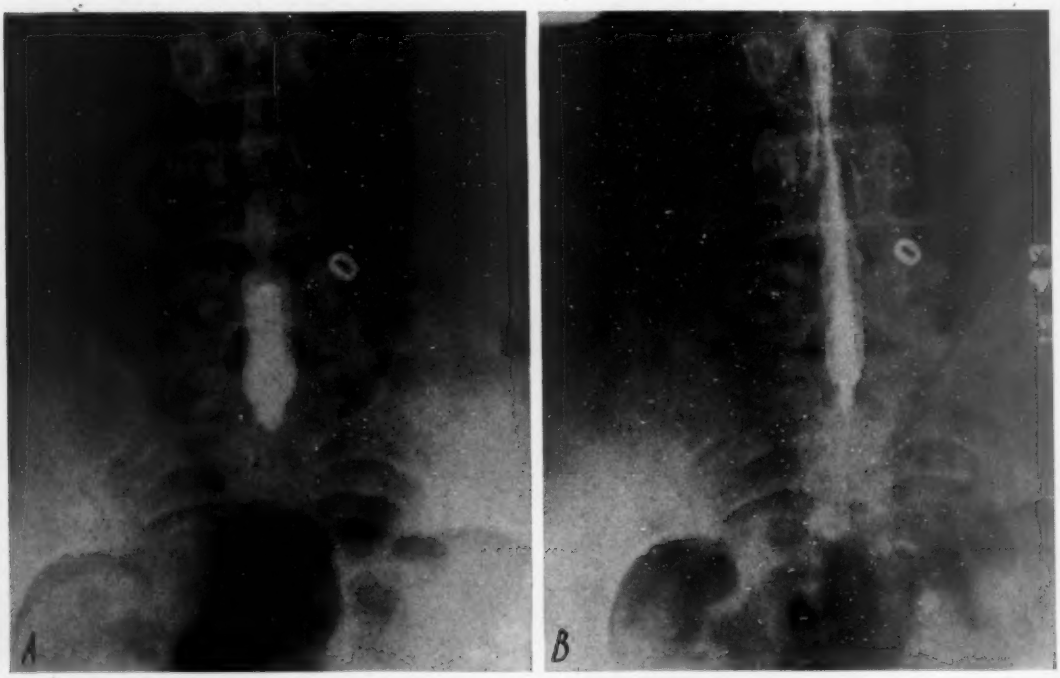

FIG. 1. *A*, column of iodized oil with patient in the erect position. Normal myelogram, with axillary pouches poorly visualized. *B*, roentgenogram taken while patient was straining as if at stool. The oil column has risen 8 cm., thinning out the density and revealing the axillary pouches of the second, third and fourth lumbar roots. Those of the fifth are better seen on the original myelogram.

* From the Radiologic Service of Dr. M. G. Wasch, and the Neurosurgical Service of Dr. L. M. Davidoff.

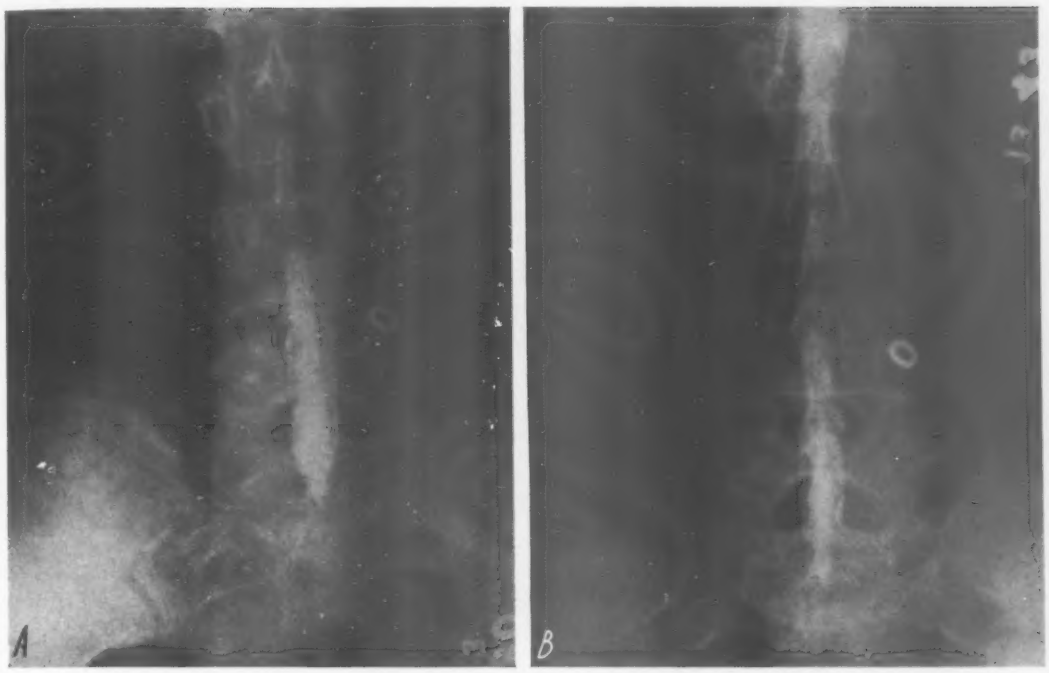

FIG. 2. *A*, same case as in Figure 1, with the patient in the supine position. *B*, myelogram taken at the height of straining. The oil column has risen more than 10 cm., and the axillary pouches are well portrayed. Note the change in density of the oil column.

down in the erect and horizontal positions after the location of the suspected pathological condition had been determined roentgenoscopically. It was thought best to obtain at least three exposures in each position with the patient at rest. Additional roentgenograms were made during the brief interval in which the patient was told to cough deeply or "strain as if you were moving your bowels."

In 18 patients straining as if at stool, forced respiration or coughing resulted in an upward excursion of the oil column within the spinal canal. The greatest rise occurred in the most cooperative patients. With the patient in the erect position the oil column rose from 3 to 7 cm., and in the prone position the ascent was greater, reaching up to 10 cm. We believe that the 2 patients who had no demonstrable response did not understand directions despite efforts to make their meaning clear.

The ascent of the oil column was usually rapid, reaching its maximum a few seconds after the increase in intra-abdominal pressure was started. The greatest response was elicited when the patient strained as if at stool. When pressure was relaxed the oil column rapidly resumed its resting position, requiring less time to recede than it did to rise. The movement may aptly be described as a "jump." It was noteworthy that when intra-abdominal pressure was gradually increased the rise of the oil column was gradual, and when pressure was suddenly increased the elevation was more rapid. The descent was rapid, occurring as soon as the increased intra-abdominal pressure was relieved. However, by relieving pressure slightly and immediately thereafter increasing intra-abdominal pressure, the oil column could be forced as high as the lower thoracic vertebral level with the patient in the erect position in several instances.

As the oil column rose its shadow became thinned peripherally. This might conceivably obscure small lateral defects. The deformity of the axillary pouches, however,

Fig. 3. *A*, shallow lateral defect in oil column on left side, fifth interspace. *B*, myelogram taken at height of straining. The lateral defect is not seen as well as in *A*, but the elevation of the suprajacent axillary pouch is better visualized. The oil column has risen 6 cm. visualizing the middle lumbar region of the canal.

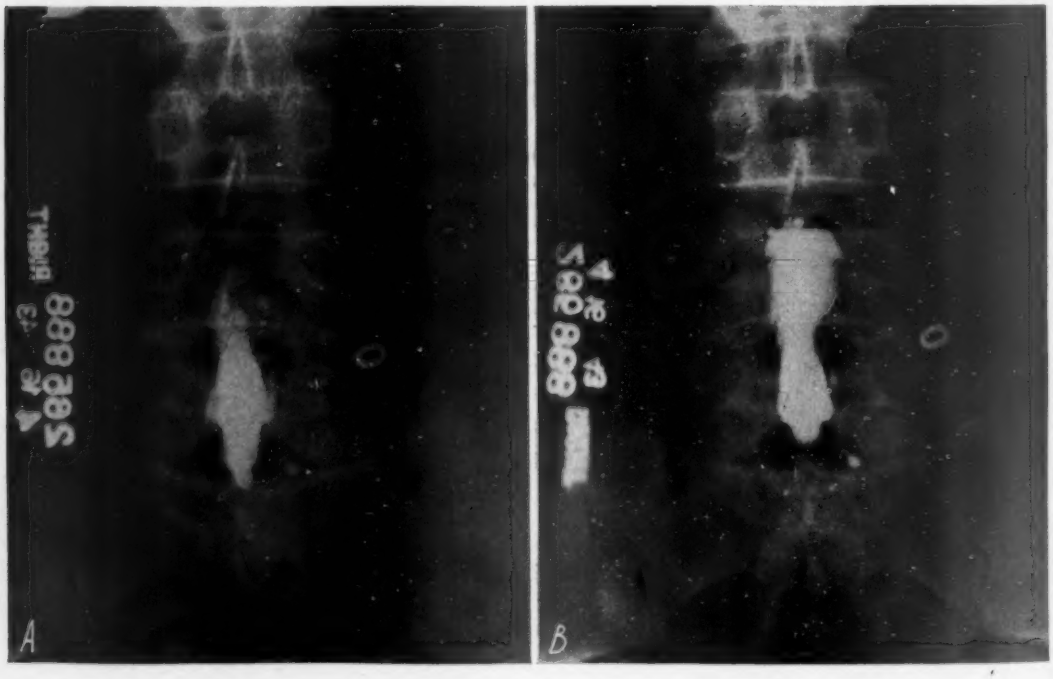

Fig. 4. *A*, myelogram taken with the patient in the erect position. The axillary pouches of the fifth lumbar segment are well portrayed. There is a suspicious thinning of the top of the oil column. *B*, myelogram taken in the erect position at the height of straining. A large defect is seen at the fourth lumbar interspace on the left side.

might be accentuated, thus avoiding diagnostic errors. Deeper lateral indentations occasionally are brought into bolder relief as the column thins out, and in these patients the axillary pouches also become more apparent. Transverse defects may be entirely hidden, the radiolucent shadow being replaced by a zone of oil less dense than that above and beneath the lesion.

The pouches in the segment above that under examination are often brought into view during strain, thereby adding to the completeness of the examination. Occasionally roentgenograms made with the patient at rest do not portray the axillary pouches adequately. These may be accentuated by requesting the patient to strain and taking the roentgenogram immediately after pressure is relaxed.

As the oil column thins out during the time a patient strains, it is possible that small projections not due to prolapsed discs may be outlined. We have not had the opportunity to observe such a patient thus far, and would recommend that this procedure be utilized when the opportunity arises.

Patients who had a sciatic distribution of pain complained of exacerbation of pain down the affected leg and occasionally the contralateral side during the time increased intra-abdominal pressure was maintained. The pain was relieved as soon as straining ceased.

COMMENT

The only reference to this subject in the literature was made by Reitan[1] 1941. Our observations, which were made without knowledge of Reitan's work, completely confirm his observations. The movement of the oil in the canal is due, we agree, to an increase in the amount of blood in the vascular bed, especially in the venous plexus between the dura and the walls of the spinal column. As tension is increased the veins dilate, decreasing the available space. When this occurs the contents of the caudal end of the canal perforce must be thinned out, and in order to accommodate the constant volume of oil in the decreased available space the oil column rises.

Roentgenoscopic observation of the oil column affords a graphic illustration of the movement of fluids within the spinal canal. This maneuver is easily performed, and should be included in routine myelographic examinations.

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REFERENCE

1. Reitan, H. On movements of fluid inside the cerebro-spinal space. *Acta radiol.*, 1941, *22*, 762–779.

OSTEOID-OSTEOMA OF THE HEAD OF THE RADIUS

CASE REPORT*

By HERBERT M. STAUFFER, M.D.

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OSTEOID-OSTEOMA was described and named by Jaffe[1] in 1935. In a subsequent communication[2] he and Lichtenstein reported conclusions based on the study of a total of 33 cases. According to these authors, osteoid-osteoma is a benign neoplasm involving a single bone in the limbs or vertebral column of adolescents and young adults, and in their opinion the roentgenogram constitutes the most important diagnostic study. The lesion gives rise to persistent localized bone pain without local heat or febrile episodes. Surgical excision has been found curative.

Two aspects of the pathologic picture explain the roentgen appearance, which is so frequently characteristic. Initially a focus of osteoblasts proliferates and forms osteoid tissue. The adjacent bone undergoes a reactive sclerosis. Thus, the roentgenogram at this stage shows a well defined radiolucent spot, usually about 1 cm. in diameter, with a variable sized surrounding zone of osteosclerosis. As the osteoid focus calcifies, its definition becomes poorer and eventually this primary lesion may be indistinguishable in the roentgenogram. A cortical lesion may stimulate sclerosis above and below it for a considerable distance in the shaft. In contrast, where the spongiosa is primarily involved the abnormal density is apt to remain relatively small and circumscribed.

The roentgen findings have been misinterpreted as representing manifestations of chronic osteomyelitis, intracortical abscess, luetic osteitis, and even osteogenic sarcoma.

The case report which follows illustrates some of the diagnostic pitfalls which may be avoided if this entity is kept in mind.

CASE REPORT

The patient, a white male, aged twenty-five, was admitted to Temple University Hospital (November 10, 1939) on the service of Dr. John Royal Moore, complaining of intermittent pain in the right elbow of about two years' duration. Discomfort was mild initially and was unrelated to trauma. During the year preceding admission, the patient had been taking considerable amounts of aspirin for control of pain.

At another hospital, roentgenograms of the elbow had been interpreted as suggesting an old infectious process, with an early malignant lesion to be ruled out. The serology was negative and antiluetic therapy failed to affect the symptoms or the roentgen appearance. At the same institution, biopsy of the roughened surface of the proximal end of the right radius on February 13, 1939, yielded material that did not permit histopathologic identification of the lesion; no pus was encountered on drilling the bone. The pain persisted following fifteen roentgen treatments, administered between June 1, 1939 and July 5, 1939, to an anterior portal measuring 6 by 6 cm.; a total of 1,575 r was given (200 kv., 0.5 mm. Cu, 1.0 mm. Al).

Physical Findings. The proximal end of the radius was enlarged and the forearm in this region was tender. Supination, pronation and extension of the forearm were limited.

The clinical findings were considered suggestive of sarcoma involving the head of the radius.

Roentgen Findings. (Fig. 1.) Thickening and increased density of the proximal radial diaphysis extend distad about 3 cm. from a point just below the head of the bone. Adjacent to the articular surface there is a circumscribed, spherical, radiolucent area. The articular surface of the radius is intact and there is no abnormality otherwise of the elbow joint.

This appearance was interpreted as indicating chronic osteomyelitis—the radiolucent zone representing localized bone destruction.

Pathological Findings. (Report of Dr. Ernest E. Aegerter.) The proximal portion (5 cm.) of the right radius was resected by Dr. J. R. Moore.

Gross Description: (Fig. 2.) The specimen is the head of the right radius measuring 5 cm. in

* From the Department of Radiology, Temple University Medical School and Hospital, Philadelphia.

Fig. 1. Roentgenograms of right elbow.

length. The cartilaginous joint surface shows nothing of pathologic significance. In the epiphysis of the bone, directly below the joint surface cartilage, there is a spheroid mass measuring approximately 1.4 cm. in diameter. It is of a reddish brown color, somewhat pale in the center. It is sharply delineated from the surrounding bone tissue. Its consistency is rather soft, though palpation reveals the presence of gritty material, probably calcified bone spicules. There is roughening and thickening of the contiguous cortical tissue.

Histopathologic Description: (Fig. 3.) The central portion or nidus of this lesion is made up of irregular masses of calcified osteoid. This tissue is composed of coarse bundles among which are interspersed numerous large cells of varying size and shape. A lamellar pattern is lacking. These coarse, irregular masses are lined along their surfaces by a row of osteoblasts, and here and there are cells resembling osteoclasts. The ground substance consists of pleomorphic,

Fig. 2. Photograph of proximal end of radius, sectioned longitudinally.

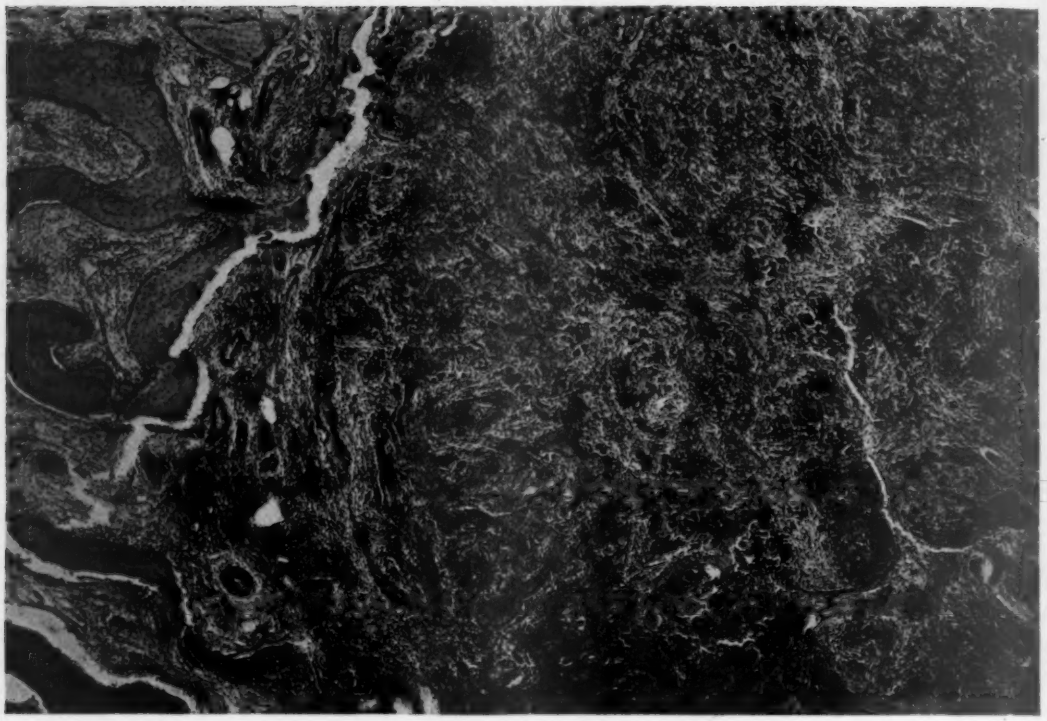

Fig. 3. Low power (approximately ×35) photomicrograph showing osteoid focus.

spindle, collagen-producing cells. Giant cells are common throughout the lesion. The osteoid trabeculae in the outer zone show less calcium. In these regions there is the pigmentation of old hemorrhage. The tumor mass is sharply demarcated from the surrounding spongiosa. About its periphery the bone trabeculae are thickened and heavy. Osteoblasts are numerous on their surfaces and the intertrabecular tissue is quite densely fibrotic. There is no histological evidence of an infectious process.

The original pathological diagnosis was "healing benign giant-cell tumor." Review of the roentgenograms recently suggested osteoid-osteoma as a more likely possibility. The clinical, roentgenological and pathological features of the case are all in keeping with the latter diagnosis.

Following operation the patient was relieved of pain and he has remained in good health.

REFERENCES

1. Jaffe, H. L. "Osteoid-osteoma"; benign osteoblastic tumor composed of osteoid and atypical bone. *Arch. Surg.*, 1935, *31*, 709–728.
2. Jaffe, H. L., and Lichtenstein, L. Osteoid-osteoma: further experience with this benign tumor of bone, with special reference to cases showing the lesion in relation to shaft cortices and commonly misclassified as instances of sclerosing non-suppurative osteomyelitis or cortical-bone abscess. *J. Bone & Joint Surg.*, 1940, *22*, 645–682.

MILITARY ROENTGENOLOGICAL TRAINING*

By LIEUTENANT COLONEL HENRY G. MOEHRING
Medical Corps, Army of the United States

THE mission of the United States Army Medical Department is the conservation of man power—the preservation of the strength of the military forces. This is accomplished in several ways: (1) by selecting for and enrolling in the Armed Forces individuals physically fit for military service; (2) by maintaining these individuals in good physical condition, and (3) by furnishing evacuation, hospitalization and medical treatment to those who become disabled in order to restore them quickly to health and fighting efficiency.

Roentgenologists aid in accomplishing the Medical Department's mission. In the selection of personnel for the armed forces, standard roentgen diagnostic procedures are utilized in evaluating the individual's physical fitness; roentgen examination of the chest is mandatory and is accomplished at most induction stations by photoroentgenography. Although the maintenance of the health of the military forces is largely a matter of sanitation and immunization, induction center activities also contribute to the preventive medicine program. The roentgenologist's assistance in restoring the disabled to health is fundamentally the same, and just as great, as in any medical practice; adverse environmental factors and the necessity for speedy restoration to fighting efficiency work some modification, however.

That real and valuable help comes from roentgenologists is, then, self-evident. What has been done within the army to insure that this valuable aid be on a sound scientific basis? The number of qualified, well trained radiologists available is inadequate, hence a training program to meet this shortcoming, at least in part, has been set up.

The general training in clinico-roentgenology which anyone associated with the roentgen department receives is, of course, present in military hospitals as well as in civilian institutions. Definitive training, however, is of greater interest: a six weeks' intensive basic course in roentgenology for medical officers is conducted at the Army School of Roentgenology; roentgenographic technicians are trained in several medical department technicians schools; a twelve weeks' "advanced" course in roentgenology forms part of the Mayo Foundation's instruction program for medical officers.

The purpose of the basic course at the Army School of Roentgenology is to train junior officers of the Medical Corps to serve as assistant roentgenologists. The majority of the students are ordered to the School because they are interested in taking the course or their duty assignment requires more knowledge of roentgen diagnosis than they possess. The basic training is composed of lectures, demonstrations, special problems, teaching seminars and applicatory exercises, chiefly in the form of practical examinations.

The main portion of the first two weeks' lecture program is devoted to physical and chemical fundamentals interspersed with several demonstrations and examinations. A particularly instructive type of examination is the small group, oral discussion of a number of different roentgenographic units; this serves to emphasize the practical importance of electrophysics. The remaining four weeks are devoted almost exclusively to diagnostic roentgenology. As each lecture subject comes to an end, a roentgenogram interpretation examination is held; the students are asked to render reports on a number of different roentgenographic studies and then those studies are discussed.

During the entire course, various "semi-

* Presented before the Thirteenth Annual Conference of Teachers of Clinical Radiology, Chicago, Ill., June 6, 1943.

nars" are conducted; the class is divided into groups of about ten officers and each "seminar" is attended by a single group. This type of instruction is given in physics, foreign body localization, stereoscopy, trouble-shooting, roentgenoscopy, roentgenography, and roentgenogram interpretation.

Since the students are Army officers as well as doctors of medicine, drill, a retreat formation and a weekly inspection receive their due allotment of training time.

Each student is required to prepare a special problem for presentation to his class. Each student's special problem covers a narrow topic in roentgen diagnosis so that the literature on the subject can be reasonably reviewed. The presentation must include representative roentgenograms and a concise summary of roentgen findings as well as pertinent, collaborative data. A brief written report on each special problem is also submitted.

The evaluation of the student officers is based on personal contact with the teaching staff and special problem presentations as well as on the examinations. A report of each student's performance at the school is forwarded to his Commanding Officer and to the Surgeon General's Office.

The twelve weeks' course at the Mayo Foundation is intended as a continuation of the basic course or as added training for men with some previous roentgenological experience. The first two weeks are devoted to an intensive lecture series on the basic and clinical features of roentgenology. The following ten weeks are devoted to clinical observation, roentgenogram interpretation, quiz conferences and teaching seminars. Each student is required to attend all roentgenogram reporting sessions in addition to his rotating assignments in various roentgen department activities.

Several suggestions may be made as regards roentgenological training of young men, who may ultimately enter the Service, but are at present undergoing instruction as civilians in civilian institutions.

The need in the Armed Forces is for roentgen diagnosticians; the more experience and training in diagnosis the man receives between now and his entry into the Service, the better will he help meet that need. Concentration of training on diagnosis is suggested. This is especially true in regard to roentgenoscopic approach to diagnosis.

A roentgenologist's high index of suspicion toward minimal reinfection type of tuberculosis stands the Armed Forces in good stead at the induction stations. Experience in diagnosis and in following progress of pulmonary tuberculosis is therefore important.

There should be at least a slight acquaintance with the roentgen manifestations of tropical diseases.

A working knowledge of electrophysics as applied to power sources and roentgenographic equipment will save time-consuming confusion in the event that direct, low frequency or polyphasic current sources are encountered. Improvised techniques, as well as equipment may well be the only means of keeping a roentgen department functioning; with service men available only after long waits, a knowledge of practical electrophysics again is useful. A knowledge of several makeshift foreign body localization techniques will not come amiss.

Efficient management of a roentgen department from the standpoint of expediting examinations and reports saves many hospital days. Since speedy restoration to good health and to full duty are of military significance, proper organization of a department will save not only hospital days but military effective days; acquisition of familiarity with the administration of a roentgenological department will pay worth while dividends.

WAR TIME GRADUATE MEDICAL MEETINGS*

By EDWARD L. BORTZ, CAPT. (MC) USNR.

PREVIOUS to the outbreak of war, it was my privilege to be associated with the postgraduate training activities of the American College of Physicians, as a member of the Committee on Postgraduate Courses. The College was setting up these courses in such places as the Mayo Clinic, the Continuation Center in Minneapolis, Harvard University, Johns Hopkins University and several other outstanding teaching centers throughout the country. They covered various special fields and lasted from one to six weeks and served as stimulating refresher courses for groups of men who felt they wanted such training.

Just about the time of the outbreak of war, when the military activity of the United States began its accelerated program, there began to appear a desire for postgraduate instruction for physicians already in the Service and those who were about ready to join the Armed Forces. As a result of these indications, certain inquiries were made and a few courses, under the auspices of the American College of Physicians, were established in the various special fields in Service hospitals, especially in the Philadelphia, Boston and Chicago areas.

The staffs and commanding officers of the hospitals received them most gratefully and offered recommendations that these courses be expanded.

CREATION

As the result of these contacts with the Service doctors, a joint effort was made by the American Medical Association, the American College of Surgeons and the American College of Physicians to create a plan whereby similar courses in special branches of medicine might be carried to Service men all over the country. The main objective of the three organizations was to make available to the vast number of medical officers, who are not located near large medical centers, the latest medical advances through short periods of instruction. It was a challenge to American medicine.

This plan was conceived not to displace the excellent teaching programs already established in many of the Service hospitals but it was designed to place at the disposal of these hospitals and medical officers everywhere the vast reservoir of present day medical knowledge.

It was the hope of the men creating this program that the periods of postgraduate instruction could be conducted by specialists in the various fields at Service hospitals where the need and desire for such courses were apparent. Such instruction would be carried there in the form of ward rounds, study groups, clinical demonstrations, moving pictures and question and answer periods.

Once the need was apparent and the facilities available whereby such courses could be organized, the committee, composed of one member from each of the three organizations, approached the Surgeons General of the Army, Navy and Public Health Service for authorization to proceed with the work. Their approval was given and the committee then felt free to advance the plan.

ORGANIZATION

Regional Committees. With the work now ready to begin, the country was divided into twenty-four sections and for each section a committee of three was appointed. These men were selected by Brigadier General Fred Rankin, Brigadier General Hugh Morgan, Doctors James Paullin and Irvin Abell. They are doctors who have executive ability, know the civilian faculties and can implement the program in their particular area. With few exceptions, these seventy-two men responded affirmatively and enthusiastically.

The duties of the regional committee

* Presented at the Thirteenth Annual Conference of Teachers of Clinical Radiology, Chicago, Ill., June 6, 1943.

members as outlined to them are as follows:

1. To be responsible for the details of programs at each Service hospital in their respective regions, where programs are to be conducted.

2. To be responsible for the selection of teachers and speakers, with the assistance of the Central Committee and of the National Consultants.

3. To arrange time of meetings and schedules of travel and appearance of the teachers within their respective territories.

4. To furnish copies of the programs to the Commanding Medical Officers of the hospitals.

5. Supervision of expenses, which shall be limited to necessary travel costs; also the forwarding of statements of same to the Secretary of the Central Committee.

6. To obtain from the Commanding Officers at the end of the period of instruction a written statement concerning their impressions, and those of their staff, regarding the value of the courses, and suggestions for improvement.

National Consultants. At the same time these physicians were appointed to serve on the regional committees, a group of thirty-four nationally known and outstanding men were invited to serve on the Board of National Consultants, covering thirty-one fields of medicine. Without exception these men accepted this invitation and have responded to the call for action.

The Board of National Consultants is composed of:

Robert A. Cooke—Allergy
John S. Jundy—Anesthesia
Lieut. Col. William P. Holbrook—Aviation medicine
Louis H. Clerf—Broncho-esophagology
William D. Stroud—Cardiovascular problems
Chester S. Keefer—Chemotherapy
Chester N. Frazier—Dermatology
Lieut. Col. Thomas T. Mackie—Dysenteries
Walter L. Palmer—Gastrointestinal diseases
David P. Barr—General internal medicine
Irvin Abell—General surgery
Roy R. Kracke—Laboratory medicine
Henry E. Meleney—Malaria
Tracy J. Putnam—Neurology and neurosurgery
John B. Youmans—Nutrition
Col. Harry S. Gradle—Ophthalmology
George E. Bennett and Frank D. Dickson—Orthopedic surgery
Capt. Harry P. Schenck—Otolaryngology
Frank H. Krusen—Physical therapy
Robert H. Ivy—Plastic and maxillofacial surgery
Arthur H. Ruggles and Edward A. Strecker—Psychiatry
John Romano—Psychosomatic medicine
Col. B. R. Kirklin—Radiology
Francis G. Blake—Respiratory diseases
Ralph Pemberton—Rheumatism and arthritis
Lieut. Col. Douglas B. Kendrick and Capt. Lloyd R. Newhouser—Shock, burns, blood derivatives
Leo Eloesser—Thoracic surgery
Frederick A. Coller—Traumatic surgery of the abdomen
Col. Esmond R. Long—Tuberculosis
Herman L. Kretschmer—Urology
J. R. Heller—Venereal diseases

The duties of the National Consultants are:

1. Each Consultant to prepare a specimen six hour teaching schedule for a one day period.

2. To organize a National Faculty.

3. To cooperate with the regional committees in working out local programs and securing the teachers.

Specimen Programs. The first thing we asked the National Consultants to do was draw up a specimen program. They completed this task very promptly and we now have a group of programs that would be welcomed by any group of physicians seeking instruction.

These programs have been mimeographed and sent to the committee members, who will use them in drawing up programs for their own districts. They have likewise been sent to the Commanding Officers of the Army and Navy hospitals, the Surgeons General and to the leading men in American medicine. All have been exceptionally well pleased with the type of program submitted.

National Faculty. The National Faculty was organized in order to pool the Nation's outstanding teachers, and thereby meet the requirements of the various Service hospitals. It consists of civilian doctors and those men who are already in the Service, who

will be available through the cooperation of their Commanding Officers.

Obviously teachers of renown will not be asked to visit a camp or station where there are but three or four medical officers. On the other hand, plans are being built around hospitals where there are at least thirty-five medical officers, and to these meetings will be invited doctors from nearby medical establishments and also civilian physicians.

In addition to the men who are being contacted by the National Consultants, we have written to the deans of the medical schools and from fifty-five of them we have had enthusiastic responses practically placing their faculties at the disposal of the committee. Of course, through all these avenues there will be some duplication, but we do feel that in this way all of the outstanding men of medicine can be approached and their cooperation enlisted.

As you well know, a number of our fine teachers have tried every possible lane of approach to get into the Services today only to be ruled out for one reason or another. The War Time Graduate Medical Meetings, however, offer them the opportunity to come closer to the man in the Service by going out on a one, two, three or possibly seven day tour of the hospitals.

CONCLUSION

The interest on the part of the doctors, both civilian and those in the Services, in the medical meetings being offered is greater than ever before. There is a seriousness of application and a positive desire to gain knowledge of all new advances in medicine. Medical science today is progressing by leaps and bounds.

The effort and time expended by the Central Committee and the three organizations behind the War Time Graduate Medical Meetings have been doubly repaid by the enthusiasm and cooperation received. The urge to do something in behalf of American medicine to better equip doctors for carrying the highest type of modern scientific medicine directly to the front, where our boys are getting the best that medical science has to offer, is strong. Such a program, I believe, is eminently worth while and undoubtedly will prove most successful.

A SIMPLE METHOD FOR MEASURING PEAK VOLTAGE IN DIAGNOSTIC ROENTGEN EQUIPMENT*†

By RUSSELL H. MORGAN, M.D.
CHICAGO, ILLINOIS

DURING the past several decades there has accumulated an extensive literature* on methods for measuring roentgen voltage. Of the various procedures which have been suggested, most are based on the use of such instruments as the spark gap, the high resistance voltmeter, the electrostatic voltmeter, the spectrograph and the condenser voltmeter. Of these, the spark gap is probably the best known to radiologists. Its wide usage may be attributed to its simplicity of operation and a precision sufficiently great for most roentgenographic applications. Its principal disadvantages include tendencies toward erratic performance in the presence of surges and transients and during humid weather.

In recent years the spark gap has been replaced in many roentgen-ray laboratories by the more reliable high resistance voltmeter.[9] This latter instrument possesses high inherent precision and sufficient flexibility that it may be used to measure peak,[10,11] root mean square, and average volts. Furthermore, when adapted to cathode-ray oscillography[12] it simultaneously permits an examination of the voltage wave-form of a roentgen generator. Originally the high resistance voltmeter was a large bulky device. The immersion of the resistance elements in oil, however, allows a considerable reduction in the instrument's size.

The electrostatic voltmeter has found some use in therapeutic roentgenology. Since it measures root mean square rather than peak volts it is not suitable for roentgenographic calibrations.

The spectrograph and condenser voltmeter have been more widely applied in Europe than in the United States. They are essentially laboratory instruments and do not possess the flexibility of the high resistance voltmeter.

In recent years the measurement of roentgen voltage has been complicated somewhat by the introduction of shockproof equipment. In order to tap the high tension circuits of modern roentgen apparatus, auxiliary junction boxes and cables are necessary. This supplementary apparatus reduces considerably the practicability of making voltage measurements outside of a well equipped laboratory, and accordingly most roentgen machines are calibrated at the factory before installation.

Under certain circumstances peak voltage may be determined with sufficient precision for general roentgenographic purposes from absorption data. For example, Müller[7] suggests a method wherein peak voltage may be determined from half-value layer measurements. The outstanding advantage of methods based on the absorption principle is that no tapping of the roentgen circuits is required; furthermore, measurements may be made with relatively simple apparatus. These methods, therefore, are particularly well suited to radiologists who may wish to check the calibration of their machines from time to time, and to servicemen who are not infrequently called upon to calibrate roentgenographic equipment in the field.

A simple absorption method for measuring roentgen voltage has been used successfully in this laboratory for some time. The procedure is not dissimilar to that described by Duane[2,3] for determining the effective wave length of a roentgen beam. The ap-

* An excellent review of this literature was published a few years ago by Müller.[7]

* From the Division of Roentgenology, the University of Chicago.
† The work described in this paper was done under a contract recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the University of Chicago.

paratus required includes a direct-reading photoelectric roentgen-ray intensitometer* similar in general design to the roentgenographic exposure meters previously described by the writer,[6] copper filters 0.5 and 1.0 mm. in thickness and aluminum filters 1 and 2 mm. in thickness. An ionometric intensitometer is equally suitable although the curves presented below strictly apply only to photoelectric intensitometers in which the radiation detector includes a phototube, a type B fluoroscopic screen, and an overlying aluminum filter 0.5 mm. in thickness. To make a voltage determination by means of this apparatus, the radiation detector of the intensitometer is placed beneath the roentgen tube to be tested at a target-detector distance of 1 meter or more. Exposures are then made, first with 1.5 mm. of copper and then with 1 mm. of copper in the roentgen beam if the kilovoltage is suspected of being over 50 kv. (peak), and first with 3 mm. of aluminum and then with 2 mm. of aluminum if the kilovoltage is suspected of being below 50 kv. (peak). The deflection of the intensitometer is noted in each instance and the ratio of the two readings calculated. This determination is then applied to Figure 1 if copper filtration has been used, or to Figure 2 if the measurements have been made with aluminum filtration. Peak kilovoltage is read directly from the curves. For example, suppose that roentgen-ray exposures made with 1.5 and 1 mm. of copper filtration in the roentgen beam produce intensitometer deflections of 26 and 69 divisions respectively. The ratio of the two readings is 0.38. An examination of Figure 1 indicates that the peak voltage applied to the roentgen tube was 73 kilovolts.

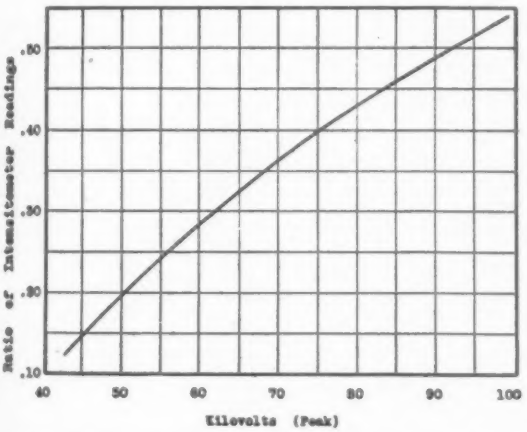

Fig. 1. Relation between peak roentgen kilovolts and the ratio of intensitometer readings made with 1.5 and 1.0 mm. of copper filtration.

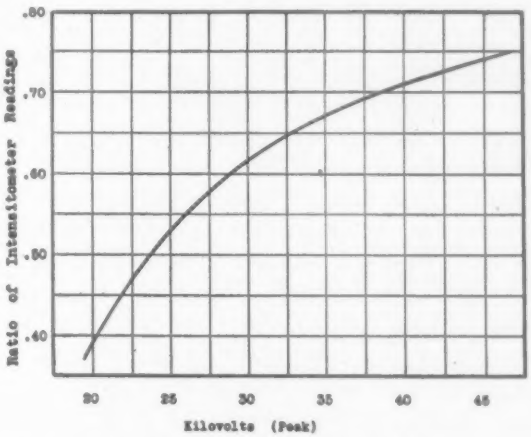

Fig. 2. Relation between peak roentgen kilovolts and the ratio of intensitometer readings made with 3.0 and 2.0 mm. of aluminum filtration.

When taking intensitometer readings it is desirable to diaphragm the roentgen-ray beam in order to prevent possible error from scattered radiation. An aperture of 1.5 cm. has been found satisfactory if the diaphragm-radiation detector distance exceeds 30 cm. Under this condition the amount of scattered radiation reaching the

* As developed in this laboratory, the photoelectric intensitometer is constructed in two parts, a radiation detector and a meter unit. The radiation detector includes a phototube, preferably of the multiplier type, an overlying fluorescent screen, and an aluminum filter 0.5 mm. in thickness. The meter unit includes a microammeter with which the current developed by the phototube is recorded, and a power supply for the various intensitometer circuits. When the radiation detector is placed beneath a roentgen tube and a roentgen beam projected through it, the fluorescent screen is activated. In response to the fluorescent radiation the phototube conducts a small current which is recorded by the microammeter. The instrument is so designed that meter deflections are proportional to the intensity of the light emitted by the fluorescent screen, which in turn is a function of the intensity of the roentgen radiation. For exposure meter service it is convenient to calibrate the scale of the microammeter in terms of exposure time. When the intensitometer is to be used for the determination of roentgen voltage, however, it is preferable to calibrate the microammeter scale in arbitrary units of 0 to 100.

radiation detector is reduced to below 1 per cent of the total amount of radiation.

The exposure times with which the intensitometer readings are made are not critical so long as they exceed the time required for the microammeter needle to reach its resting position. When it is desired to use exposure times shorter than this the two exposures must be made with identical exposure times. If this precaution is observed readings made even with extremely short exposure times (e.g. 1/20 second) will not be in error.

The data from which Figures 1 and 2 were prepared were derived from copper and aluminum absorption curves made from measurements conducted with a photoelectric roentgen-ray intensitometer in which the radiation detector included a multiplier phototube, a type B fluorescent screen, and an overlying aluminum filter 0.5 mm. in thickness. The roentgen generator was a full wave, valve-rectified machine in which oscillographic tracings demonstrated that the minimum voltage was approximately 25 per cent of the peak voltage. The voltage applied to the roentgen tube during each determination was measured with a high resistance precision vacuum tube voltmeter.

The various copper absorption curves approached essentially straight-line characteristics for voltages below 100 kv. (peak) when the thickness of copper was 1 mm. or less. The aluminum absorption curves produced at and below 50 kv. (peak) approached straight-line characteristics when the thickness of aluminum was 2 mm. or less.* In view of these observations it is evident that the curves presented in Figures 1 and 2 are essentially independent of the inherent filtration of present-day roentgen tubes, and also the wave-form of the roentgen generator. Comparative voltage measurements made with a high resistance precision type voltmeter and a roentgen-ray intensitometer on self-rectified, mechanically rectified, and valve-tube rectified equipment may be expected to agree with one another within ± 2 per cent. This is a better correlation than may be obtained between measurements made with a precision high resistance voltmeter and a spark gap. It, therefore, is believed that the intensitometric method is sufficiently precise for general roentgenographic purposes.

* These results are in good accord with those published by Taylor and Singer,[5] Holthusen and Gollwitzer,[4] and others,[1,6] when it is pointed out that the inherent filtration of the radiation detector of the intensitometer was approximately 1.5 mm. of aluminum, and that of the roentgen tube window was 0.5 mm. of aluminum.

SUMMARY

A simple method for measuring the peak kilovoltage applied to a roentgen tube is described. The apparatus required in the procedure includes a photoelectric intensitometer similar to the exposure meters described in previous communications, and a set of two aluminum and two copper filters. The method requires no tapping of the high tension roentgen circuits, and measurements may be made quickly and easily. The method, therefore, should be valuable not only to radiologists who wish to check their roentgen equipment from time to time, but also to servicemen who are called upon to calibrate roentgen apparatus in the field.

REFERENCES

1. Behnken, H. Dosimetrische Untersuchungen über Röntgenstrahlenschutz und Strahlenschutzröhren. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1930, *41*, 245–256.
2. Duane, W. Roentgen rays of short wave-lengths and their measurement. Am. J. Roentgenol. & Rad. Therapy, 1922, *9*, 167–171.
3. Duane, W., Hudson, J. C., and Sterling, H. N. Measurement of effective wave lengths. Am. J. Roentgenol. & Rad. Therapy, 1928, *20*, 241–245.
4. Holthusen, H., and Gollwitzer, H. Die Qualitätsmessung der Röntgenstrahlen in der Tiefentherapie. *Strahlentherapie*, 1927, *26*, 101–119.
5. Jacobi, H., and Liechti, A. Ueber Spannung, Filterung, Halbwertschicht, Homogenität und Tiefendosen in der Tiefentherapie. *Strahlentherapie*, 1928, *29*, 503–523.
6. Morgan, R. H. Studies in roentgenographic exposure meter design. Am. J. Roentgenol. & Rad. Therapy, 1942, *48*, 88–98.

7. Müller, K. W. Das Problem der Röhrenspannungsmessung. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 66–86.
8. Taylor, L. S., and Singer, G. Standard absorption curves for specifying the quality of x-radiation. *Radiology*, 1934, *22*, 445–460.
9. Taylor, L. S. Apparatus for measurement of high constant or rippled voltages. *Radiology*, 1931, *16*, 893–904.
10. Weyl, C., Warren, S. R., Jr., and McPhedran, F. M. Methods of measuring and recording roentgen-ray tube currents and voltages. Am. J. Roentgenol. & Rad. Therapy, 1931, *26*, 871–877.
11. Weyl, C., Warren, S. R., Jr., and Garrahan, C. J. A thyratron peak voltmeter. Am. J. Roentgenol. & Rad. Therapy, 1932, *28*, 544–546.
12. Williams, M. M. D. Two instruments for measuring x-ray tube voltage. *Radiology*, 1942, *38*, 80–83.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Forty-fourth Annual Meeting: Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Palmer House, Chicago, Ill., Sept. 24–29, 1944.

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Twenty-eighth Annual Meeting: 1944, to be announced.

EDITORIALS

JOINT MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY AND THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

IT HAS been a little over ten years since the combined societies of North America held the First American Congress of Radiology. At the time of that meeting a Century of Progress Exposition was being held in Chicago. All the world was then apparently at peace and while the Century of Progress was primarily an American exposition, many countries over the world had feature attractions; among the exhibitors were Italy, Japan, China, Sweden, Czechoslovakia, Ukrania, and Belgium. How long ago that seems in the light of the happenings of the last several years! China and Japan have been at war for seven years, starting a conflagration which soon spread to other nations until now most of the nations of the earth are at war and American citizens are scattered across the face of the globe participating in the gigantic struggle for what mankind calls freedom.

This year there is to be held a meeting of two of America's outstanding societies—the Radiological Society of North America and the American Roentgen Ray Society. Published elsewhere in this issue of the JOURNAL is a Preliminary Program of this Joint Meeting, which is to be held at the Palmer House in Chicago, Illinois, September 24 to 29, 1944. Dr. E. R. Witwer, President of the Radiological Society and Dr. L. C. Kinney, President-Elect of the American Roentgen Ray Society and their program committee have arranged, in spite of many difficulties, a most comprehensive program. Quite naturally, in view of the times, many of the subjects deal primarily with phases of roentgenology pertinent to the war, and the United States Government has generously granted leave to members of the Armed Forces to participate in the Joint Meeting. Major General N. T. Kirk, Surgeon General of the Army will be personally represented by Colonel B. R. Kirklin, Vice Admiral Ross T. McIntire, Surgeon General of the Navy, by Lieutenant Commander Robert K. Arbuckle, and Dr. Thomas H. Parran, Surgeon General of the United States Public Health Service, by Dr. Waldron Sennott, P/A Surgeon, U.S.P.H.S.

The combined meeting of the two societies necessitates the arrangement of a program which lends itself to certain group discussions. Consequently the various scientific sessions will be held under a General Assembly, a Diagnostic Section and a Therapy Section. The grouping of the papers in this manner makes for easier attendance at the section in which one's interest primarily lies.

The two featured lectures of the societies—the Carman Lecture of the Radiological Society and the Caldwell Lecture of the American Roentgen Ray Society—have been combined as the Caldwell-Carman Lecture and this will be given on Tuesday evening. The banquet will be held on Thursday evening.

The Refresher Courses which have become a prominent feature of the meetings of both Societies will again be offered and in these courses there will be made available concentrated and specialized instruction in some of the more difficult and interesting phases of radiology. These courses

will be under the direction of highly qualified instructors. The detailed program of these Refresher Courses was published in the July issue of this JOURNAL, as well as in the July issue of *Radiology*.

The Scientific Exhibits promise to be of much importance covering many phases of the more recent developments and advances in diagnostic and therapeutic radiology. The Commercial Exhibits, too, give every promise of being extensive and important. Newer advances, many of which have resulted from experience gained in military activities, will be explained and demonstrated.

To all the interested members of the Armed Forces a cordial invitation is extended to attend this Joint Meeting.

It is suggested that all who anticipate attending the meeting should make their reservations at the Palmer House as soon as possible to avoid conflicts.

WILLIAM McDOWELL DOUGHTY
1881—1944

DR. WILLIAM McDOWELL DOUGHTY, of Cincinnati, Ohio, a nationally known radiologist, died of coronary occlusion at his farm in Lawrenceburg, Indiana, on April 18, 1944, at the age of sixty-two. Dr. Doughty was born on November 4, 1881, in Covington, Kentucky, and obtained his early education there. He attended Miami Medical College (now the Medical College of the University of Cincinnati) and was graduated from there in 1906. He served an eighteen months' internship at the Cincinnati General Hospital, after which he did post-

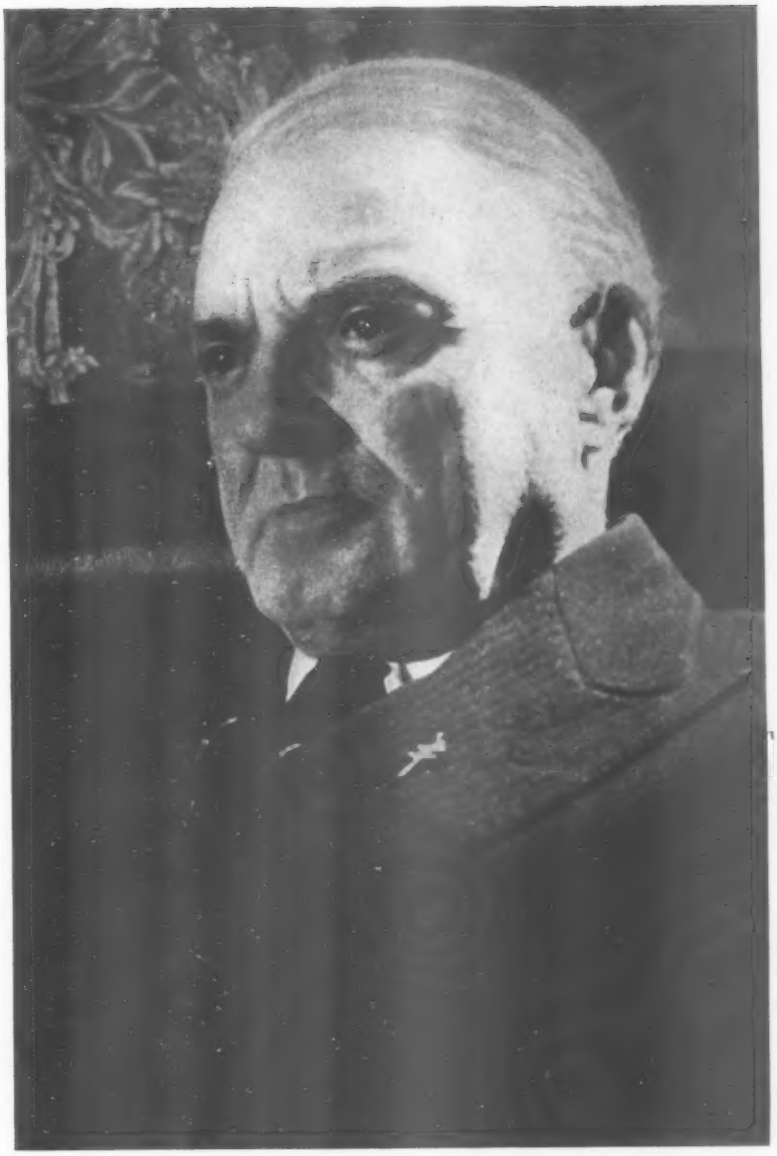
graduate work for one year in Vienna and London.

In addition to maintaining a private practice Dr. Doughty was Associate Professor of Radiology and Associate Director of the Department of Radiology at the College of Medicine of the University of Cincinnati and at General Hospital, and at the time of his death he was chief Radiologist at Christ Hospital and Senior Radiologist at Children's Hospital.

Dr. Doughty was not only an outstanding radiologist but he was one of Cincinnati's leading citizens, taking an active part in the civic affairs of the city. In 1936 he was made a member of the Board of Directors of the University of Cincinnati at which time he resigned his positions in the College of Medicine of the University. He was President of the Cincinnati Academy of Medicine in 1933 and President of the American Roentgen Ray Society in 1941–1942, the Society holding one of its most successful meetings in 1941 in Cincinnati under his presidency. He was also a member of the American Medical Association, the Radiological Society of North America, the American College of Radiology, a diplomate of the American Board of Radiology, a life member of the American College of Surgeons, and he was a member of the Silicosis Board of Referees of the Industrial Commission of Ohio.

Dr. Doughty accomplished much during his life time and was the recipient of many honors. In all of his associations he gave more of himself than he received. He had the faculty of making friends and to him the making of a friend was a thing accomplished. He was primarily a physician, secondarily a specialist in radiology. He was considerate of his associates and he was at all times able to consider agreeably and weigh an opposing point of view. Dr. Doughty's wise counsel and friendly smile will be greatly missed both by those who were closely associated with him and by his many friends in the various groups and organizations to which he belonged.

E. R. Bader



H. KENNON DUNHAM
1872—1944

DR. DUNHAM is dead. Certainly none could ever have said that about him until mortal life ceased in his body. An inquisitive investigator of zeal and enthusiasm, he sought the reasons and causes of things going on in the human chest, using the roentgen ray as his tool of study. When first he sought the answers for abnormal densities noted on x-ray chest plates of patients with pulmonary tuberculosis, he realized that primarily must be known the normal; then and then only could be studied and understood the abnormal. He spent the greater part of two years, from 1915 to 1917, with Dr. William Snow Miller, anatomist of the University of Wis-

consin, mapping out the normal anatomy of the lungs, on microscopic slides and x-ray chest plates, at the same time building up an interpretation of the abnormal as studied by the same methods. By such methods of study it has become possible for us now to make mental dissections of the lungs of our living patients, as laid bare on chest roentgenograms. The contributions of anatomist, pathologist and clinician were joined, molding a basic pattern for the interpretation of abnormal roentgen-ray densities in terms of pathological tissue changes in the lungs. Such was his aim and accomplishment in life.

H. Kennon Dunham was born at Fairview, Ohio, March 3, 1872, son of Dr. William Henry and Mary (McPherson) Dunham. He married Amelia Hickenlooper of Cincinnati, March 14, 1905, and had two children; Harry, the only son, was killed in military action while flying in New Guinea. Amelia, the daughter, survives. Dr. Dunham was graduated in Medicine from the Miami Medical College in 1894, pursued post-graduate work at Johns Hopkins Hospital in 1896 and later at Great Ormand St. Hospital and St. George's Hospital in London in 1899. These researches were extended and finished at the University of Wisconsin in collaboration with Dr. William Snow Miller and Dr. Henry Bunting in 1915 to 1917. He was Associate Professor of Medicine, Head of the Department of Tuberculosis at the University of Cincinnati; Medical Director at the Hamilton County Tuberculosis Hospital from 1914 to 1940. He served in the Medical Corps of the U. S. Army during World War I as Captain and Major. He held the following responsible positions of honor: President, Cincinnati Academy of Medicine, 1921; President, Ohio Public Health Association, 1930–1932; President, National Tuberculosis Association, 1934–1935; President, Cincinnati Anti Tuberculosis League; Chairman, Cincinnati Christmas Seals Committee. He was a member of the American Medical Association, American College of Physicians (Fellow), Ohio State Medical Association, American Clinical and Climatological Association, American Association of Thoracic Surgery, American Trudeau Society, American Roentgen Ray Society, Radiological Society of North America, American College of Radiology (Fellow) and a diplomate of the American Board of Internal Medicine.

Dr. Dunham had been very active in the rehabilitation work of the Veterans Bureau, serving on the Medical Council for many years, and in the American Legion. Some of his last efforts were in this work. After returning home from a Committee Meeting of the National Tuberculosis Association in New York concerned with the problems of tuberculosis in veterans, he developed bronchopneumonia and was confined to his bed for five weeks. While convalescing from this acute illness an attack of coronary thrombosis occurred and he died suddenly on April 27, 1944, at his home in Cincinnati, Ohio.

He served and inspired others to serve. His interest and affiliations were wide but focused chiefly on the roentgen diagnosis of pulmonary tuberculosis and the control of this disease. His mark in these fields is permanent.

John H. Skavlem

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. H. Dabney Kerr, University Hospital, Iowa City, Iowa. Annual meeting: Joint Meeting of American Roentgen Ray Society and Radiological Society of North America, Palmer House, Chicago, Ill., Sept. 24–29, 1944.

American College of Radiology
Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association
Secretary, Dr. U. V. Portmann, Cleveland Clinic, Cleveland, Ohio.

Arkansas Radiological Society
Secretary, Dr. J. S. Wilson, Mack Wilson Hospital, Monticello, Ark. Meets every three months and also at time and place of State Medical Association.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: Joint Meeting of American Roentgen Ray Society and Radiological Society of North America, Palmer House, Chicago, Ill., Sept. 24–29, 1944.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Walter L. Kilby, Baltimore. Meets third Tuesday each month, September to May.

Section on Radiology, California Medical Association
Secretary, Dr. Earl R. Miller, University of California Hospital, San Francisco, Calif.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Max Climan, 242 Trumbull St., Hartford, Conn. Meets bi-monthly on second Thursday, at place selected by Secretary. Annual meeting in May.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. H. W. Ackemann, 321 W. State St., Rockford, Ill.

Radiological Section, Los Angeles County Medical Association
Secretary, Dr. Roy W. Johnson, 1407 S. Hope St., Los Angeles, Calif. Meets on second Wednesday of each month at the County Society Building.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Brooklyn Roentgen Ray Society
Secretary, Dr. Leo Harrington, 880 Ocean Ave., Brooklyn, N.Y. Meets monthly on fourth Tuesday, October to April.

Buffalo Radiological Society
Secretary, Dr. Joseph S. Gian-Francheschi, 610 Niagara St., Buffalo, N. Y. Meets second Monday of each month except during summer months.

Chicago Roentgen Society
Secretary, Dr. F. H. Squire, 1754 W. Congress St., Chicago 12, Ill. Meets second Thursday of each month October to April inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. Samuel Brown, 707 Race St., Cincinnati, Ohio. Meets third Tuesday of each month, October to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. D. D. Brannan, 11311 Shaker Blvd., Cleveland 4, Ohio. Meets at 6:30 P.M. at Allerton Hotel on fourth Monday each month, October to April, inclusive.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meetings held in Dallas on odd months and in Fort Worth on even months, on third Monday, at 7:30 P.M.

Denver Radiological Club
Secretary, Dr. Edward J. Meister, 366 Metropolitan Bldg., Denver, Colo. Meets third Friday of each month at Denver Athletic Club.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

Florida Radiological Society
Acting Secretary, Dr. Walter A. Weed, 204 Exchange Bldg., Orlando, Fla. Meetings in May and November.

Georgia Radiological Society
Secretary, Dr. James J. Clark, 478 Peachtree St., Atlanta, Ga. Meets in November and at annual meeting of Medical Association of Georgia in the spring.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month at a place designated by the president.

Illinois Radiological Society
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. H. C. Ochsner, Methodist Hospital, Indianapolis. Meeting held the second Sunday in May annually.

Kentucky Radiological Society
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

Long Island Radiological Society
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:30 P.M.

Louisiana Radiological Society
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

Michigan Association of Roentgenologists
Secretary, Dr. E. M. Shebesta, 1429 David Whitney Bldg., Detroit. Three meetings a year, Fall, Winter, Spring.

Milwaukee Roentgen Ray Society
Secretary, Dr. C. A. H. Fortier, 231 W. Wisconsin Ave., Milwaukee, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. Annette T. Stenstrom, 1218 Medical Arts Bldg., Minneapolis, Minn. One meeting a year at time of Minnesota State Medical Association.

Nebraska Radiological Society
Secretary, Dr. D. A. Dowell, Medical Arts Bldg., Omaha, Nebr. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

Radiological Society of New Jersey
Secretary, Dr. H. R. Brindle, 501 Grand Ave., Asbury Pk. Meets annually at time and place of State Medical Society. Mid-year meetings at place chosen by president.

New York Roentgen Society
Secretary, Dr. Ramsay Spillman, 115 East 61st St., New York City. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Roentgen Ray Society
Secretary, Dr. Major Fleming, Rocky Mount, N. C. Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

NORTH DAKOTA RADIOLOGICAL SOCIETY
Secretary, Dr. L. A. Nash, St. John's Hospital, Fargo. Meetings held by announcement.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse. Three meetings a year. January, May, November.

OHIO RADIOLOGICAL SOCIETY
Secretary, Dr. J. E. McCarthy, 707 Race St., Cincinnati. Meets at time and place of annual meeting of Ohio State Medical Association.

PACIFIC ROENTGEN SOCIETY
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. L. E. Wurster, 416 Pine St., Williamsport.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. R. P. Barden, University Hospital, Meetings first Thursday of each month from October to May inclusive at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

PITTSBURGH ROENTGEN SOCIETY
Secretary, Dr. R. G. Alley, 4800 Friendship Ave. Meets second Wednesday each month, 4:30 P.M., October to June, Pittsburgh Academy of Medicine.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. Murray P. George, Strong Memorial Hospital. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY
Secretary, Dr. A. M. Popma, 220 N. First St., Boise, Idaho.

ST. LOUIS SOCIETY OF RADIOLOGISTS
Secretary, Dr. E. W. Spinzig, 2646 Potomac, St. Louis, Mo. Meets fourth Wednesday of each month, except June, July, August, and September, at a place designated by the president.

SAN DIEGO ROENTGEN SOCIETY
Secretary, Dr. Henry L. Jaffe, Naval Hospital, Balboa Park, San Diego, Calif. Meets monthly on first Wednesday at dinner.

SAN FRANCISCO RADIOLOGICAL SOCIETY
Secretary, Dr. Martha Mottram, 450 Sutter St., San Francisco. Meets monthly on third Thursday at 7:45 P.M., first six months of year at Toland Hall, University of California Hospital, second six months at Lane Hall, Stanford University Hospital.

SHREVEPORT RADIOLOGICAL CLUB
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

SOUTH CAROLINA X-RAY SOCIETY
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston on first Thursday in November, also at the time and place of South Carolina State Medical Association.

TENNESSEE RADIOLOGICAL SOCIETY
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. Asa E. Seeds, Baylor Hospital, Dallas, Texas. Next annual meeting, Temple, Texas, January 17, 1945.

UNIVERSITY OF MICHIGAN DEPARTMENT OF ROENTGENOLOGY STAFF MEETING
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets every Thursday from 4:00–5:00 P.M., Room 301, Service Memorial Institute.

VIRGINIA RADIOLOGICAL SOCIETY
Secretary, Dr. E. L. Flanagan, 116 E. Franklin St., Richmond, Va. Meets annually in October.

WASHINGTON STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Thomas Carlile, 1115 Terry St., Seattle. Meets fourth Monday each month, October through May, College Club, Seattle.

X-RAY STUDY CLUB OF SAN FRANCISCO
Secretary, Dr. J. M. Robinson, University of California Hospital. Meets monthly in evening on third Thursday.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Medical Members' meeting held monthly on third Friday at 2:30 P.M. and Ordinary Meeting at same time on following Saturday, October to May, 32 Welbeck St., London, W.1.

SECTION OF RADIOLOGY OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month at 4:45 P.M. at the Royal Society of Medicine 1, Wimpole St., London, W. 1.

FACULTY OF RADIOLOGISTS
Secretary, Dr. M. H. Jupe, 32 Welbeck St., London, W. 1 England.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Keith Hallam, St. George's Hospital, K.E.W., Melbourne, E. 4, Victoria, Australia. Meets monthly from March to November inclusive.

CANADIAN ASSOCIATION OF RADIOLOGISTS
Secretary, Dr. A. D. Irvine, 540 Tegler Bldg., Edmonton, Alberta.

SECTION OF RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Anderson, Invercargill, New Zealand. Meets annually.

SOUTH AMERICA

SOCIEDAD ARGENTINA DE RADIOLOGIA
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

CONTINENTAL EUROPE

SOCIEDAD ESPANOLA DE RADIOLOGIA Y ELECTROLOGIA
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)
Secretary for French language, Dr. A. Grosjean La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse Biel. Meets annually in different cities.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banul Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD: USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

JOINT MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY AND THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

PALMER HOUSE, CHICAGO, ILLINOIS, SEPTEMBER 24–29, 1944

PRELIMINARY PROGRAM

Monday, September 25, 1944

General Assembly

10:30 A.M.

Sherwood Moore, M.D., President, American Roentgen Ray Society, Presiding.

H. Dabney Kerr, M.D., Secretary of Session.

1. Call to Order. Sherwood Moore, M.D., St. Louis, Missouri.
2. Greetings. Josiah J. Moore, M.D., President, Chicago Medical Society, Chicago, Illinois.
3. Response. Eldwin R. Witwer, M.D., Chairman Coordinating Committee, Detroit, Michigan.
4. Address: "A Study of the Ureters in Bladder Neck Obstructions." Herman L. Kretschmer, M.D., President, American Medical Association, Chicago, Illinois, and Fay H. Squire, M.D., Chicago, Illinois.
5. Address: Colonel B. R. Kirklin, M.C., A.U.S., representing Major General Norman T. Kirk, Surgeon General, M.C., A.U.S., Washington, D. C.
6. Address: "Pantopaque Myelography: Correlation of Roentgenological and Neurosurgical Findings." Lieutenant Commander Robert K. Arbuckle, M.C., U.S.N.R., representing Vice Admiral Ross T. McIntire, Surgeon General, M.C., U.S. Navy, and Lieutenant C. H. Shelden, M.C., U.S.N.R., and Lieutenant R. H. Pudenz, M.C., U.S.N.R., Bethesda, Maryland.

Monday Afternoon, September 25, 1944

Diagnostic Section

2:00 P.M.

Group of Papers pertaining to CHEST

Eldwin R. Witwer, M.D., Presiding.

David Beilin, M.D., Secretary of Session.

1. "Progressive Bilateral Bullous Emphysema" George Teplick, M.D. (by invitation), and Allison Price, M.D. (by invitation), Philadelphia, Pa.
2. "Non-disabling Bronchiectasis." Major Archie Fine, M.C., A.U.S., National Army Air Center, Nashville, Tenn.
3. "Roentgenograms of the Chest in Mental Deficiency." Joseph T. Danzer, M.D., Oil City, Pa.

Recess 3:30 to 4:00 P.M.

Review Exhibits

4. "Planigraphy. III. An Evaluation of the Method in the Diagnosis of Cancer of the Lower Respiratory Tract." J. Robert Andrews, M.D., Cleveland, Ohio, and Captain Robert O. Turck, M.C., A.U.S. (by invitation).
5. "The Roentgenological Aspect of Tuberculous Calcification. A Clincial and Experimental Study." Robert G. Bloch, M.D. (by invitation), Chicago, Illinois.
6. "Miniature Chest Fluorography with Control Study." Harry Hauser, M.D., and Carroll C. Dundon, M.D. (by invitation), Cleveland, Ohio.

Monday Afternoon, September 25, 1944

Therapy Section

2:00 P.M.

U. V. Portmann, M.D., Presiding.

John S. Bouslog, M.D., Secretary of Session.

1. "The Value of Orchidectomy in the Treatment of Carcinoma of the Male Breast." T. Leucutia, M.D., Detroit, Michigan.
2. "Testicular Irradiation in Carcinoma of the Prostate." Arbor D. Munger, M.D. (by invitation), Lincoln, Nebraska.
3. "An Improved Technique for the Treatment of Carcinoma of the Testis." Major Milton Friedman, M.C., A.U.S., and Lieutenant Colonel L. G. Lewis, M.C., A.U.S. (by invitation), Washington, D. C.

Recess 3:30 to 4:00 P.M.

Review Exhibits

4. "A Review of Sixty-five Cases of Malignant

Tumors of the Testes." Major J. L. Barner, M.C., A.U.S., Atlanta, Georgia.

5. "Contact Roentgen Therapy for Carcinoma of the Bladder." Lowell S. Goin, M.D., Los Angeles, Calif.
6. "Roentgen Therapy in the Treatment of Marie-Strümpell Spondylarthritis (Spondylitis Rhizomelica)." Robert J. Reeves, M.D., and James E. Hempill, M.D. (by invitation), Durham, North Carolina.

Tuesday, September 26, 1944

General Assembly

10:30 A.M.

Eldwin R. Witwer, M.D., Presiding.

Donald S. Childs, M.D., Secretary of Session.

1. Installation of the President-Elect of the American Roentgen Ray Society, Lyell C. Kinney, M.D., San Diego, California, by Sherwood Moore, M.D., President, American Roentgen Ray Society and Charles W. Heacock, M.D., Chairman, Executive Council, American Roentgen Ray Society.
2. Inaugural Address. Lyell C. Kinney, M.D., President, American Roentgen Ray Society.
3. "The Roentgen-Ray Examination in the Urinary Tract with Special Reference to Methods and Findings in Cases of Testicular Tumors." Lieutenant Colonel Joseph C. Bell, M.C., A.U.S., Major Gilbert J. Heublein, M.C., A.U.S. (by invitation), and Captain Howard J. Hammer, M.C., A.U.S. (by invitation), Percy Jones General Hospital, Battle Creek, Michigan.
4. "X-Ray Findings in Chest Examinations of 120,000 Government Employees." Waldron Sennott, M.D., P/A Surgeon, U.S.P.H.S., United States Marine Hospital, Staten Island, N. Y., representing Surgeon General Thomas H. Parran, U.S.P.H.S.
5. "Radiation Necrosis of the Skull." Lieutenant Commander John D. Camp, M.C., U.S.N.R., United States Naval Hospital, Oakland, California.
6. "Coccidioides Infection of the Lungs." Lieutenant Colonel John L. Davis, M.C., A.U.S. (by invitation), Captain Ivan H. Munk, M.C., A.U.S. (by invitation), and Captain Samuel H. Boyer, M.C., A.U.S. (by invitation), Camp Haan, Riverside, California.

Tuesday Afternoon, September 26, 1944

Diagnostic Section

2:30 P.M.

Group of Papers Pertaining to Gastrointestinal Tract

Lyell C. Kinney, M.D., Presiding.

Chas. W. Heacock, M.D., Secretary of Sesssion.

1. "Antral Gastritis: Roentgenologic and Gastroscopic Findings." Walter W. Vaughan, M.D., Durham, N.C.
2. "Congenital Duodenal Obstruction." Ernest Kraft, M.D., Friedrich G. Kautz, M.D. (by invitation), and James R. Lisa, M.D. (by invitation), New York, N.Y.
3. "Diaphragmatic Hernia and Dilated Esophageal Ampulla; Their Clinical Significance." Jacob Abowitz, M.D., Los Angeles, California.
4. "Diverticula of the Small Intestine." Max Ritvo, M.D., Boston, Mass.
5. "Regional Ileitis." Samuel Brown, M.D., Cincinnati, Ohio.
6. "Differential Diagnosis Between Benign and Malignant Gastric Ulcers." Lewis Gregory Cole, M.D., White Plains, New York.

Tuesday Afternoon, September 26, 1944

Therapy Section

2:30 P.M.

Heddy S. Shoulders, M.D., Presiding.

James N. Collins, M.D., Secretary of Session.

1. "Hematological and Clinical Characteristics of Leukemias." Russell L. Haden, M.D. (by invitation), Cleveland, Ohio.
2. "Clinical and Hematological Observations on One Hundred Patients with Various Types of Blood Dyscrasias Treated with Radioactive Phosphorus." E. H. Reinhard, M.D., and C. V. Moore, M.D. (by invitation), St. Louis, Missouri.
3. "Leukemia—Results of Roentgen Treatment." Bernard P. Widmann, M.D., Philadelphia, Pa.
4. "The Experimental Production of Leukemia with Roentgen Rays." P. S. Henshaw, Ph.D. (by invitation), Bethesda, Maryland.
5. "Some Studies with Radioactive Sodium in Leukemic and Non-leukemic Mice." Edith

H. Quimby, M.Sc., and Titus C. Evans, Ph.D. (by invitation), New York, N. Y.

6. "Metabolic Changes Produced in Humans by Roentgen Rays." (To be read by title.) Anna Goldfeder, M.D. (by invitation), New York, N. Y.

TUESDAY EVENING. SEPTEMBER 26, 1944

8:30 P.M.

Grand Ball Room
Caldwell-Carman Lecture
Lawrence Reynolds, M.D.
Detroit, Michigan

WEDNESDAY, SEPTEMBER 27, 1944

General Assembly

10:30 A.M.

Lyell C. Kinney, M.D., Presiding.
H. Dabney Kerr, M.D., Secretary of Session.

1. Address: Eldwin R. Witwer, M.D., President Radiological Society of North America, Detroit, Michigan.
2. "Some Considerations Concerning the Roentgen Examination of the Head." Eugene P. Pendergrass, M.D., and Charles R. Perryman, M.D. (by invitation), Philadelphia, Pa.
3. "Radiological Aspects of Public Health Work." Herman E. Hilleboe, M.D. and Russell H. Morgan, M.D. (by invitation), Bethesda, Maryland.
4. "The Roentgen Changes Associated with Pancreatic Fibrosis." Edward D. Neuhauser, M.D. (by invitation), Boston, Massachusetts.
5. "Radioactive Sodium as a Tracer in the Study of Peripheral Vascular Disease." Beverly C. Smith, M.D. (by invitation), and Edith H. Quimby, M.Sc., New York, N. Y.
6. "Streamlining Roentgen Therapy for War Time Service." Captain Albert Soiland, M.C., U.S.N.R., United States Naval Hospital, Long Beach, California.
7. Roentgen Demonstration of Cecal Deformity in Amebiasis." Ross Golden, M.D., and Paul H. Ducharme, M.D. (by invitation), New York, N. Y.

WEDNESDAY AFTERNOON, SEPTEMBER 27, 1944

Diagnostic Section

2:00 P.M.

Group of Papers Pertaining to
OSSEOUS SYSTEM

Edgar P. McNamee, M.D., Presiding.
Harold G. Reineke, M.D., Secretary of Session.

1. "Differential Diagnosis of Tuberculosis in Joints of the Extremities." Raymond W. Lewis, M.D., New York, N. Y.
2. "Derangements of the Knee. The Diagnostic Scope of Soft Tissue Examination with the Vacuum Technique." Lieutenant Commander J. Gershon-Cohen, M.C., U.S.N.R., U. S. Naval Hospital, Sampson, N. Y.
3. "Post Traumatic Para-Articular Calcifications and/or Ossifications of the Ankle." Captain Arnold D. Piatt, M.C., A.U.S., Fort Myers, Florida.

RECESS 3:30 TO 4:00 P.M.

Review Exhibits

4. "The Development of Bone Sarcoma Following Irradiation." C. Howard Hatcher, M.D. (by invitation), Chicago, Illinois.
5. "Lesions of the Intervertebral Disc in the Cervical Region." J. E. Whiteleather, M.D., R. E. Semmes, M.D. (by invitation), and Francis Murphy, M.D. (by invitation), Memphis, Tenn.
6. "Roentgenographic Observations in Age Atrophy (Osteoporosis) of the Spine." G. J. Marum, M.D. (by invitation), Greenville, Miss.
7. "Deossifications Regional to Joints of Extremities." Colonel A. A. de Lorimer, M.C., A.U.S., Memphis, Tenn.

WEDNESDAY AFTERNOON, SEPTEMBER 27, 1944

Therapy Section

2:00 P.M.

Robert S. Stone, M.D., Presiding.
Edgar C. Baker, M.D., Secretary of Session.

1. "Roentgen Therapy for Brain Tumors." Percival Bailey, M.D. (by invitation), and T. J. Wachowski, M.D. (by invitation), Chicago, Illinois.
2. "Roentgen Therapy of Primary Neoplasm of the Brain and Brain Stem." C. B. Peirce, M.D., W. V. Cone, M.D. (by invitation), A. E. Elvidge, M.D. (by invita-

tion), and J. C. Tye, Jr., M.D. (by invitation), Montreal, Canada.

3. "Neurosurgical Treatment of Patients with Advanced Malignant Diseases." Gayle Crutchfield, M.D. (by invitation), University, Virginia.

Recess 3:30 to 4:00 p.m.

Review Exhibits

4. "Irradiation of Pituitary Tumors." W. S. Lawrence, M.D., Memphis, Tennessee.
5. "Roentgen Therapy for Encephalitis." U. V. Portmann, M.D., and Roger Lough, M.D. (by invitation), Cleveland, Ohio.
6. "Simplification of Tissue Dose Estimation in Roentgen Therapy." Anna Hamann, M.D. (by invitation), Chicago, Illinois.

Thursday, September 28, 1944

General Assembly

10:30 a.m.

Eldwin R. Witwer, M.D., Presiding.

Donald S. Childs, M.D., Secretary of Session.

1. "The Morgan X-Ray Exposure Meter and Phototimer." Paul C. Hodges, M.D., Chicago, Illinois.
2. "Scout Film of the Abdomen." Lieutenant Colonel Joseph Levitin, M.C., A.U.S., Camp Cooke, California.
3. "Clinical Cineradiography—Brazilian Method." Jose Jany, M.D. (by invitation), and Joaquin Martins Garcia, M.D., Radiologist, Official Delegate Ministerio Aeronautics (by invitation), Sao Paulo, Brazil.
4. "Analysis of Factors Affecting the Diagnostic Quality of the Roentgen Image." Russell H. Morgan, M.D. (by invitation), Bethesda, Maryland.
5. "The Importance of Recognizing Protrusions of the Gastric Mucosa in Military Personnel." Commander Wendell G. Scott, M.C., U.S.N.R., United States Naval Hospital, Seattle, Washington.
6. "Abdominal Aortography—A New Simplification of the Technique." Pedro L. Farinas, M.D., Habana, Cuba.

Thursday Afternoon, September 28, 1944

Diagnostic Section

2:30 p.m.

Group of Papers pertaining to Head

Lewis G. Allen, M.D., Presiding.

W. Walter Wasson, M.D., Secretary of Session.

1. "The Roentgen Anatomy of the Skull in the Newborn Infant." Samuel G. Henderson, M.D., and Louise M. Sherman, M.D. (by invitation), Pittsburgh, Pa.
2. "Midline Anomalies of the Brain." Arthur P. Echternacht, M.D., and John A. Campbell, M.D. (by invitation), Indianapolis, Ind.
3. "Lesions of the Aqueduct of Sylvius." Hugh M. Wilson, M.D. (by invitation), New Haven, Conn.
4. "Tuberous Sclerosis of the Brain." A. W. Marcovich, M.D. (by invitation), and Earl Walker, M.D. (by invitation), Chicago, Illinois.
5. "Observations on the Presence of Subdural Gas after Pneumoencephalography." Lester W. Paul, M.D., and T. C. Erickson, M.D. (by invitation), Madison, Wisconsin.

Thursday Afternoon, September 28, 1944

Therapy Section

2:30 p.m.

Zoe A. Johnston, M.D., Presiding.

Leland E. Holly, M.D., Secretary of Session.

1. "Results of Irradiation Treatment of Ovarian Tumors." H. Dabney Kerr, M.D., and R. A. J. Einstein, M.D. (by invitation), Iowa City, Iowa.
2. "The Problem of Secondary Infection in Carcinoma of the Cervix." Manuel Garcia, M.D. (by invitation), and J. V. Schlosser, M.D. (by invitation), New Orleans, La.
3. "Irradiation Failures in Early Carcinoma of the Cervix—Is Surgery or Irradiation Preferable?" Franz Buschke, M.D. (by invitation), and S. T. Cantril, M.D., Seattle, Washington.
4. "Indications and Limitations of Transvaginal Roentgen Therapy for Cancer of the Cervix." Arthur W. Erskine, M.D., Cedar Rapids, Iowa.
5. "Bone Tumors—A Review of Cases from Bellevue Hospital, New York." Rieva Rosh, M.D., and Louis Raider, M.D. (by invitation), New York, N. Y.

Thursday Evening, September 28, 1944

8:00 p.m.

Banquet

Grand Ball Room

Edward L. Jenkinson, M.D., Presiding, Chicago, Illinois.

Speaker: Doctor Franklyn B. Snyder, President Northwestern University, Chicago, Illinois.

FRIDAY, SEPTEMBER 29, 1944
General Assembly

10:30 A.M.
Lyell C. Kinney, M.D., Presiding.
H. Dabney Kerr, M.D., Secretary of Session.

1. "Osteochondritis Dissecans of the Supratrochlear Septum of the Humerus." Lieutenant Commander W. E. Crysler, A/Surgeon, R.C.N.V.R. (by invitation), and Surgeon Commander H. S. Morton, R.C.N.V.R. (by invitation), Esquimalt, British Columbia.
2. "Subcortical Cyst-like Lesions of Joints." Dallas B. Phemister, M.D. (by invitation), Chicago, Illinois.
3. "Cardiac Changes in Arteriovenous Fistula." Major R. C. Pendergrass, M.C., A.U.S., Ashford General Hospital, White Springs, Virginia.
4. "Cystourethrography." Fred O. Coe, M.D., Washington, D. C.
5. "The Roentgenological Aspects of Therapeutic Pneumoperitoneum." Ernest A. Schmidt, M.D., Denver, Colorado.
6. "Relaxation of Intrinsic Spasm in Pyloroduodenal Area." Lester A. Smith, M.D., Indianapolis, Indiana.

FRIDAY AFTERNOON, SEPTEMBER 29, 1944
Diagnostic Section

2:30 P.M.
Miscellaneous Papers
Eldwin R. Witwer, M.D., Presiding.
Warren W. Furey, M.D., Secretary of Session.

1. "Roentgen Appearances in Collapse of the Lung and its Subdivisions. A Preliminary Report." Laurence L. Robbins, M.D. (by invitation), and Clayton H. Hale, M.D. (by invitation), Boston, Mass.
2. "Gas Gangrene." Captain Maurice D. Sachs, M.C., A.U.S., Port of Embarkation, San Francisco, Calif.
3. "Extrapleural Pneumothorax in the Treatment of Pulmonary Tuberculosis. Three to Five Year Follow Up of 48 Cases." F. H. Alley, M.D. (by invitation), Memphis, Tenn.
4. "Some Experiences with Angiography." Earl R. Miller, M.D., San Francisco, Calif.
5. "Specifications for the Fluoroscopist's Dark Adaptation Goggles." W. Edward Chamberlain, M.D., and Ann Chamberlain (by invitation), Philadelphia, Pa.
6. "Unusual Urinary Calculi." E. J. Bertin, M.D., Philadelphia, Penna.

FRIDAY AFTERNOON, SEPTEMBER 29, 1944
Therapy Section

2:00 P.M.
Charles H. Heacock, M.D., Presiding.
Clyde K. Hasley, M.D., Secretary of Session.

1. "The Treatment of Hemangiomas." G. E. Pfahler, M.D., Sc.D., L.L.D., Philadelphia, Penna.
2. "Treatment of Hemangioma with Roentgen Rays." James V. Prouty, M.D., Cedar Rapids, Iowa.
3. "Cancer of the Skin." Henry J. Ullmann, M.D., Santa Barbara, California.
4. "Post-irradiation Cutaneous Necrosis. A Study of its Mechanism, Course and Treatment." H. B. Hunt, M.D., and D. H. Breit, M.D. (by invitation), Omaha, Nebraska.
5. "The Radon Ointment Treatment of Irradiation Ulcers." Robert E. Fricke, M.D., and Marvin M. D. Williams, Ph.D. (by invitation), Rochester, Minn.
6. "Evaluation of Roentgen Therapy for Filariasis." Lieutenant H. L. Jaffe, M.C., U.S.N.R. (by invitation), San Diego, Calif.

AMERICAN ROENTGEN RAY SOCIETY

This is an official notice to the members of the American Roentgen Ray Society that the Forty-fourth Annual Meeting of the Society will be held at the Palmer House, Chicago, Illinois, September 24–29, 1944. This is a joint meeting with the Radiological Society of North America.

The Executive Council Meeting of the American Roentgen Ray Society will be held in Private Dining Room No. 5 on September 24, 1944, at 10 A.M.; Scientific Sessions (Joint Meeting), Grand Ballroom, 10:30 A.M., September 25–29; Executive Business Sessions, Grand Ballroom, 4:30 P.M., September 26 and 28; Caldwell-

Carman Lecture, Grand Ballroom, 8:30 P.M., September 26; Annual Banquet, Grand Ballroom, 8:00 P.M., September 28. Refresher Courses daily Sunday, September 24, through Friday, September 29. Complete program of these courses published in the July, 1944, issue of this JOURNAL.

Communications relative to business matters of the American Roentgen Ray Society should be addressed to the Executive Council, in care of its Chairman, Dr. Charles H. Heacock, 915 Madison Avenue, Memphis, Tennessee, to arrive not later than September 21.

H. DABNEY KERR, *Secretary*

SECTION ON RADIOLOGY OF THE AMERICAN MEDICAL ASSOCIATION

At the meeting of the American Medical Association held in Chicago, Illinois, June 12–16, 1944, the following officers were elected in the Section on Radiology for the ensuing year: *Chairman*, Dr. Edwin C. Ernst, St. Louis, Mo.; *Secretary*, Dr. U. V. Portmann, Cleveland, Ohio; *Executive Committee*, Dr. Edwin C. Ernst, St. Louis, Mo., Dr. Raymond C. Beeler, Indianapolis, Ind., Dr. Robert A. Arens, Chicago, Ill.; *Representative to the American Board of Radiology*, Dr. John W. Pierson, Baltimore, Md.; *Member of the House of Delegates from the Section*, Dr. B. R. Kirklin, Rochester, Minn.

TEXAS RADIOLOGICAL SOCIETY

At the annual meeting of the Texas Radiological Society held in San Antonio, Texas, May 3, 1944, the following officers were elected for the period ending with the next annual meeting to be held on January 17, 1945, in Temple, Texas: *President*, Dr. P. E. Wigby, Houston; *President-Elect*, Dr. T. B. Bond, Fort Worth; *First Vice-President*, Dr. Herman Klapproth, Sherman; *Second Vice-President and Program Chairman*, Dr. C. A. Stevenson, Temple; *Secretary-Treasurer*, Dr. Asa E. Seeds, Dallas.

NEW ENGLAND ROENTGEN RAY SOCIETY

At the annual meeting of the New England Roentgen Ray Society held on May 19, 1944, the following officers were elected: *President*, Dr. Hugh F. Hare, Boston; *Secretary-Treasurer*, Dr. George Levene, Boston.

Vol. 52, No. 2

DEPARTMENT OF TECHNIQUE

Department Editor: Robert B. Taft, M.D., B.S., M.A., 103 Rutledge Ave. Charleston, S. C.

CHART FOR LOCATING COMMON CAUSES OF BREAKDOWNS OF ROENTGENOLOGIC EQUIPMENT*

By CARL B. BRAESTRUP
New York, New York

MANY radiologists today are faced with the problem of keeping their roentgenologic equipment in operating condition with only limited or no maintenance service from the manufacturer. When breakdowns occur the causes may in many cases not be obvious without a systematic search of all possible sources of improper operation of the equipment. The chart of Figure 1 was designed as a guide for roentgenologists and technicians in trouble shooting. It has been in use in the Department of Hospitals, New York City, for about two years and is based upon our experiences with more than two hundred roentgen-ray machines of various makes and types. The chart has purposely been limited to the more common sources of trouble and to the usual type of equipment.

Directions: Look under "Symptoms of Trouble" for the condition which best describes the abnormal operation of the equipment. The numbers on the same horizontal line indicate the most likely causes in order of their probability with check marks showing other possible sources of improper operation.

630 West 168th Street
New York 32, New York

* From Physics Laboratory, Department of Hospitals, New York.

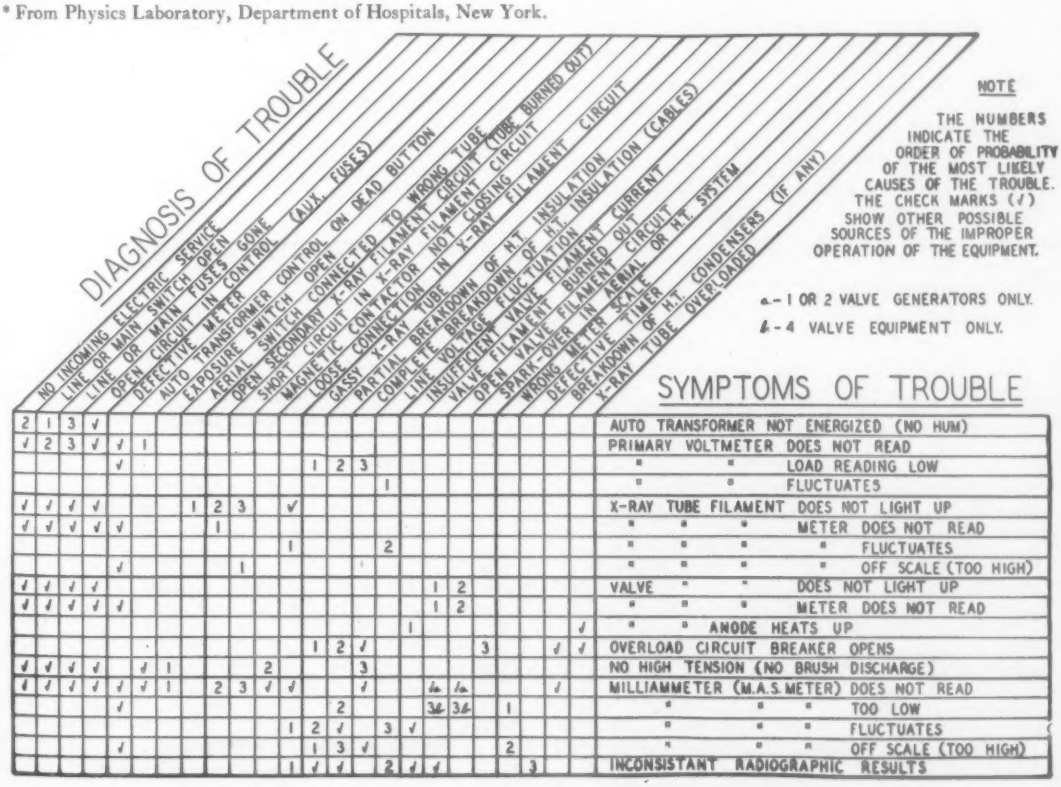

DIAGNOSIS OF TROUBLE
NO INCOMING ELECTRIC SERVICE
LINE OR MAIN SWITCH OPEN
OPEN CIRCUIT BREAKER OR MAIN FUSES GONE
DEFECTIVE METER CIRCUIT IN CONTROL (AUX. FUSES)
AUTO TRANSFORMER CONTROL ON DEAD BUTTON
EXPOSURE SWITCH OPEN
AERIAL SWITCH CONNECTED TO WRONG TUBE
OPEN SECONDARY X-RAY FILAMENT CIRCUIT (TUBE BURNED OUT)
SHORT CIRCUIT IN X-RAY FILAMENT CIRCUIT
MAGNETIC CONTACTOR NOT CLOSING
LOOSE CONNECTION IN X-RAY FILAMENT CIRCUIT
GASSY X-RAY TUBE
PARTIAL BREAKDOWN OF HT INSULATION
COMPLETE BREAKDOWN OF HT INSULATION
LINE VOLTAGE FLUCTUATION
INSUFFICIENT VALVE FILAMENT CURRENT
VALVE FILAMENT BURNED OUT
OPEN VALVE FILAMENT CIRCUIT
SPARK-OVER IN AERIAL OR H.T. SYSTEM
WRONG METER SCALE
DEFECTIVE TIMER
BREAKDOWN OF H.T. CONDENSERS (IF ANY)
X-RAY TUBE OVERLOADED
NOTE
THE NUMBERS INDICATE THE ORDER OF PROBABILITY OF THE MOST LIKELY CAUSES OF THE TROUBLE. THE CHECK MARKS (√) SHOW OTHER POSSIBLE SOURCES OF THE IMPROPER OPERATION OF THE EQUIPMENT.
a - 1 OR 2 VALVE GENERATORS ONLY.
b - 4 VALVE EQUIPMENT ONLY.
SYMPTOMS OF TROUBLE
AUTO TRANSFORMER NOT ENERGIZED (NO HUM)
PRIMARY VOLTMETER DOES NOT READ
LOAD READING LOW
FLUCTUATES
X-RAY TUBE FILAMENT DOES NOT LIGHT UP
METER DOES NOT READ
FLUCTUATES
OFF SCALE (TOO HIGH)
VALVE DOES NOT LIGHT UP
METER DOES NOT READ
ANODE HEATS UP
OVERLOAD CIRCUIT BREAKER OPENS
NO HIGH TENSION (NO BRUSH DISCHARGE)
MILLIAMMETER (M.A.S. METER) DOES NOT READ
TOO LOW
FLUCTUATES
OFF SCALE (TOO HIGH)
INCONSISTANT RADIOGRAPHIC RESULTS

FIG. 1. Chart for locating common causes of breakdowns of roentgenologic equipment.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

Evans, William A., Jr. An encephalographic ratio for estimating the size of the cerebral ventricles; further experience with serial observations. *Am. J. Dis. Child.*, Nov., 1942, *64*, 820–830.

Evans, in a previous communication, proposed an encephalographic ratio for estimating the size of the cerebral ventricles and the degree of atrophy of the brain. The ratio was obtained by dividing the transverse diameter of the anterior horns by the maximum internal diameter of the skull. Measurements were made on encephalographic roentgenograms exposed in the anteroposterior projection at 30 inches with the patient horizontal and the occiput down. Considerations of magnification by projection were dealt with and the results in 212 cases were reported. In a "normal" group the great majority of the values for the ratio fell between the 0.20 and 0.25, and a statistical correlation was obtained between the diameter of the anterior horns and the internal diameter of the skull indicating that the ratio was not influenced by age or by the size of the skull. Values of the ratio between 0.25 and 0.30 were thought to represent borderline enlargement and those above 0.30 a pathologic ventricular dilatation.

In the present paper Evans reports the results of an investigation to test the effect of some technical factors and common clinical procedures on the measurements used in the ratio and of serial studies on patients to learn, if possible, the effect of varying quantities of air in the ventricles and other factors on the constancy of the ratio in the same subject.

In the first group of patients he endeavored to obtain the effect of obliquity of exposure on the value of the ratio, the skull being held in various oblique projections. His results indicate that degrees of obliquity greater than those which would be encountered in exercising moderate technical care do not produce important changes in the value of the ratio.

In another group of patients observations were made before and immediately after the withdrawal of as much spinal fluid as could be obtained. No constant or significant effect was observed in the size of the ventricles on withdrawal of the fluid. He regards this of interest, inasmuch as the spinal fluid pressure is commonly elevated after encephalography and the postencephalographic headache is commonly relieved by withdrawing spinal fluid.

In a third group of cases no effect could be observed of the size of the ventricles as expressed in the encephalographic ratio on injection of 50 cc. of a 50 per cent sucrose solution intravenously. Such solutions are sometimes used with the thought of decreasing cerebral edema and lowering intracranial pressure.

Serial studies were made over short and long periods after the air injection. It is concluded that serial determinations of the encephalographic ratio indicate a constant basis for mensuration, even with great variations in the amount of air. The roentgen exposure should be made in the anteroposterior projection in the sagittal plane with the ray vertical and with the head held with the occiput down, so that a vertical line will pass through the outer canthus of the eye and the external auditory meatus.

Many subjects showed no change in the measurements at the three and twenty-four hour periods, but in the majority there was a tendency for the ventricles to increase slightly in size in the presence of air.

The dilatation was much more pronounced in the presence of an active diffuse cerebral lesion, in which case a rapid and irreversible dilatation of the ventricles may occur.

Evans recommends that serial measurements be made for forty-eight or seventy-two hours in pneumoencephalography. If no change in the measurements occurs, the presumption is that any diffuse cerebral lesion which may be present is "fixed." If the ventricles enlarge, there is presumptive evidence that the lesion is active and progressive. The rate of enlargement seems to be proportional to the degree of "softening" of the brain.—*R. S. Bromer.*

Davies, Hugh. Report on a series of cases of head injury investigated by encephalography. *Brit. J. Radiol.*, Aug., 1942, *15*, 238–242.

The author reports a series of 150 cases of head injury sufficiently severe to require examination at a special clinic. Air was used for the encephalography in the majority of cases, oxygen in a few. The cisternal route was used in all but 14 of the cases, in which the lumbar route was used. The views were the standard Lysholm projections. Details of the technique are described. In comparing encephalograms from different sources it is necessary to take into consideration whether the air-filled part of the ventricles is nearest to or farthest from the film.

In cerebral concussion there are no changes in the outline of the ventricles; there is dilatation after contusion, greatest in the damaged area. If there has been damage to a large vessel a cerebral cyst will result. Cerebral atrophy, which occurred in a large number of cases, is indicated by increase in content of the subarachnoid space. Probably the chief factor in causing dilatation of the ventricles is damage to the vessels either within the brain tissue or in the subarachnoid space.—*Audrey G. Morgan.*

Bower, L. E., Ditkowsky, S. P., Klien, Bertha A., and Bronstein, L. P. Arteriovenous angioma of mandible and retina with pronounced hematemesis and epistaxis. *Am. J. Dis. Child.*, Dec., 1942, *64*, 1023–1029.

A case is reported of epistaxis accompanied by emesis of swallowed blood, the cause of which was an arteriovenous angioma of the mandible associated with a similar lesion of the retina. Roentgenograms of the jaw revealed a large cystic area in the left mandible. Nine months later a roentgenogram failed to reveal any bony defect. This was explained on the basis of fibrotic changes which occurred secondary to an infection of the cystic area. The patient had a localized, angiomatous malformation of the retina of the anterior venous type as indicated by the visible retinal portion of the lesion, and by the presence of a bruit and thrill over it. An enlarged bony optic canal shown in the roentgenogram suggested the possibility that the optic nerve in its entire course contained angiomatous vessels. The authors emphasize the necessity for examining the teeth and jaw in the search for an obscure cause for hematemesis or epistaxis.—*R. S. Bromer.*

NECK AND CHEST

Thomas, A. Robinson. A note on the mechanism of deglutition. *Brit. J. Radiol.*, July, 1942, *15*, 209–210.

The passage of the bolus of food down the esophagus has usually been attributed to peristalsis and gravity. But Barclay says that the bolus is sucked rather than pushed down. A case is described which seems to support this theory as in it obviously gravity plays no part at all in the act of swallowing. The subject, a man aged thirty-seven, said that he could swallow standing on his head. He was given a drink of opaque medium and told to swallow it while standing on his head. He did so and a roentgenogram, which is reproduced, was taken during the act of swallowing. The bolus rose and passed through the esophagus just as it would have done if he had been standing on his feet. The only factor that could have caused it to rise was suction.—*Audrey G. Morgan.*

Chont, L. K., and Starry, L. J. Congenital atresia of the esophagus. *Radiology*. Feb., 1943, *40*, 169–174.

Four cases of congenital atresia of the esophagus are reported and illustrated with roentgenograms, 3 from the University Hospital of the University of Oklahoma and 1 from St. Anthony's Hospital of Oklahoma City. This is an unusual condition, only about 350 cases having been reported but a part of the rarity is probably due to lack of diagnosis. Diagnosis should be made more frequently and earlier with roentgen examination.

This anomaly is often associated with others, particularly imperforate anus and atresia of the rectum. In a large percentage of the cases there is a fistula between the esophagus and rectum, as there was in all 4 of the cases here reported.

When the child is first put to the breast the first few swallows are normal while the proximal end of the esophagus is being filled. Then there is violent spasmodic coughing and regurgitation of frothy milk and mucus and rapid onset of cyanosis. Roentgen examination shows the esophagus as a blind sac ending 12 cm. from the central incisors, generally at the level of the fourth dorsal vertebra. If the roentgenogram shows the stomach distended with gas it indicated tracheo-esophageal fistula. Lipiodol should

be used instead of barium for this examination as aspiration of the barium mixture may cause bronchopneumonia. Recently the injection of air has been suggested instead of lipiodol. Treatment is only palliative.—*Audrey G. Morgan.*

Kissin, Milton, and Cohen, Abraham G. Large healed tuberculous focus (probably primary) simulating metastatic carcinoma of the lung. *Ann. Int. Med.*, Jan., 1941, *14*, 1216–1224.

Case histories with reproductions of roentgenograms of 4 patients are reported. In each case, a rather large dense shadow, due to healed, probably primary, tuberculous focus, was interpreted as due to neoplastic metastasis; proper diagnosis was based on autopsy in one case and on subsequent clinical course in the other three.

The differential diagnostic list in such solitary nodules includes healed tuberculous foci, solitary metastatic lesions, primary pulmonary neoplasms, malignant or benign (chondroma, fibroma and lipoma), and polycythemia vera.—*H. G. Moehring.*

Ackerman, Lauren V., and Bricker, Eugene M. Mediastinal emphysema and bilateral pneumothorax following radical dissection of the neck. *Arch. Surg.*, Sept., 1941, *43*, 445–450.

An autopsied case of mediastinal emphysema and bilateral pneumothorax is reported in a patient who was subjected to radical dissection of the neck for treatment of cervical metastases from carcinoma of the lip.

Surgical procedures about the neck which open the mediastinum and partially block the upper airways offer a favorable situation for the development of mediastinal emphysema; pneumothorax arises by rupture into pleural space of mediastinal blebs of air. Other mechanisms are: air under increased pressure may break through alveoli and dissect along vascular sheaths to mediastinum; air may pass directly through the wall of any thoracic viscus and infections may permit entry of air into interstitial tissues.

Prevention of this accident during surgery depends on the maintenance of a free airway. Artificial respiration is contraindicated in treatment; treatment consists of aspirating air by various means from the pleural space. Roentgen examination, especially lateral chest films, verifies the presence of mediastinal air.—*H. G. Moehring.*

Paul, Lester W. Diseases of the mediastinum and associated conditions; refresher course. *Radiology*, Jan., 1943, *40*, 10–41.

Some five years ago the Radiological Society of North America began the presentation of an annual series of refresher courses, a course of postgraduate instruction in various phases of radiology, covering both theoretical and practical aspects of the subject. This article gives the refresher course on diseases of the mediastinum, covering diseases and tumors of the mediastinal lymph nodes, primary tumors of the mediastinum other than lymph node tumors, mediastinitis, diseases of the thyroid and thymus, diseases of the spine such as tuberculosis and other infections and tumors, cardiovascular lesions that need to be differentiated from other mediastinal masses, such as enlarged left auricle, aneurysm of aorta, right-sided aorta, dilatation of the pulmonary artery and aneurysm of the innominate artery, diseases of the esophagus and stomach, such as cardiospasm, esophageal hiatus hernia and thoracic stomach, and bronchogenic carcinoma. The text is profusely illustrated with diagrams of anatomical conditions in the mediastinum and roentgenograms of the pathological conditions discussed.—*Audrey G. Morgan.*

Kornblum, Karl, Reimann, Hobart A., and Price, Alison H. Atypical pneumonia probably caused by one of the viruses of psittacine group. *Radiology*, Jan., 1943, *40*, 75–78.

This clinico-radiological conference was based on the case of a woman of fifty who had a severe shaking chill on December 20, 1941. She came to the hospital on the fifteenth day of the disease with high fever, malaise and cough. The next day a roentgenogram showed a large, dense homogeneous shadow in the lower part of the right upper lobe that suggested lobar pneumonia. There were clinical features that argued against this diagnosis, such as sudden onset in a well subject, failure of sulfadiazine treatment, low leukocyte count, unproductive cough, sweating, recurrent chills, and bradycardia. A diagnosis of virus pneumonia was then made and a complement fixation test for psittacosis apparently confirmed it.

The virus pneumonias most commonly appear in the roentgenogram as an atypical or so-called bronchopneumonia. At the beginning of the disease the shadow may be unilateral but it shows a marked tendency to become bilateral. There is nearly always accentuation of the hilar and trunk shadows, indicating tracheobronchitis. There is often diffuse haziness of the lung fields with small mottled areas of increased density scattered through both lungs. Generally the involvement is greater in one lung than in the other. It resembles the so-called influenzal pneumonias of some fifteen or twenty years ago.—*Audrey G. Morgan.*

Gordon, Joseph, and Taylor, Henry K. The post-thoracoplasty roentgenogram, with special reference to posture. *Radiology*, Jan., 1943, *40*, 42–48.

In a certain number of cases after thoracoplasty the contour of the regenerated ribs is displaced outward, giving an area of localized lateral convexity. This was seen in 63, or 80 per cent, of 78 postoperative cases in which the sputum remained positive while it was not seen in any of 75 cases successfully operated on in which the sputum remained negative for six months after operation. The authors believe that this lateral convexity overlies an unclosed cavity of aerated lung tissue. Positive pressures have been demonstrated in certain types of tuberculous cavities. Such cavities are extremely resistant to closure by any form of collapse therapy. The usual line of contour of the reforming ribs is displaced, resulting in the lateral convexity.

Post-thoracoplasty roentgenograms often do not give a correct idea of the degree of collapse. After operation there is a variable degree of scoliosis and rotation of the upper thoracic vertebrae with a convexity of the spine toward the operated side. The shoulder girdle on the same side tends to rotate medially. Therefore in order to get a correct posteroanterior roentgenogram for comparison with a preoperative film the patient must be rotated a little so that the shoulder on the operated side is a little way from the cassette. The upper scoliosis may also be corrected by having the patient incline the head toward the shoulder on the operated side. When a localized lateral convexity is seen after operation an especially careful search should be made for bacteria to determine whether there is active disease present.—*Audrey G. Morgan.*

Chester, Edward M., and Krause, George R. Lung abscess secondary to aseptic pulmonary infarction. *Radiology*, Dec., 1942, *39*, 647–654.

Little has been written about lung abscess secondary to aseptic pulmonary infarct, but it is not extremely unusual. From 1930 to 1939, 344 cases of aseptic pulmonary infarct were seen at the Cleveland General Hospital. In 174 of these cases the infarct was a significant cause of death. This article reports 17 cases of lung abscess following infarct, 11 of which were taken from these 174 cases. The other 6 cases were ones in which the correct diagnosis was made during life.

The signs of infarct are often so masked by those of abscess when the patient is first seen that infarct is not thought of. In any case of lung abscess the possibility of preceding infarct should be considered and a careful search of the history made. The characteristic feature in cases in which abscess develops is the appearance of a foul purulent sputum some days or weeks after the beginning of the infarct. This is generally accompanied by a secondary rise of temperature and an increase in the leukocyte count. If the patient has heart disease it grows worse.

If the case is seen early it is easy to follow up the development of abscess from the infarct by a series of roentgen examinations which should be made in various projections. Eighteen illustrative roentgenograms are given and 4 of the cases described in detail. The roentgenograms vary in appearance depending on size, position, age and the presence of secondary infection, pleural effusion or passive hyperemia. The infarct shadow is generally in the lower part of the lung and in the early stages often sharply demarcated at the medial border. An infarct is always adjacent to a pleural surface either peripheral or interlobar.

Among the 6 cases diagnosed ante-mortem 4 of the patients died in the hospital from the abscess. Two survived the acute illness but died in a few months without recurrence of the infarction.—*Audrey G. Morgan.*

Krause, George R., and Chester, Edward M. Infarction of the lung; clinical and roentgenologic study. *Arch. Int. Med.*, June, 1941, *67*, 1144–1156.

Of a series of 6,548 autopsies at Cleveland City Hospital, 5.2 per cent showed aseptic

hemorrhagic pulmonary infarcts, and in 2.7 per cent the infarct was a significant cause of death. The source of the thrombus was not found in 54 per cent of the cases.

In 69 per cent of the series the right lower lobe was involved alone or in combination; in 53 per cent the left lower lobe was involved alone or in combination; the remaining lobes were rarely involved alone.

Pulmonary infarct was an important cause of death in 65 per cent of 241 cases with heart disease (regardless of presence of cardiac failure), while in 103 cases without heart disease infarction was significant in only 16 per cent.

Serous pleural effusion, occasionally serosanguineous or containing bile pigments, is a common accompaniment of infarction. Hemoptysis, often repeated, with small amounts of bright red blood was the most frequent symptom; next in frequency were pain and an increase in dyspnea. The usual physical signs were of consolidation and pleural effusion; a pleural friction rub was present in some cases. Temperature pulse and respiratory rates increased on the same day infarction occurred. Secondary abscess developed in some infarcts.

The shape of the roentgenographic shadow of the infarct varies with the projection, hence the importance of exposures in more than one position; the density is less than that of lobar pneumonia and it changes little in twenty-four hours. At times only horizontal streaking similar to localized atelectasis is seen. Pleural effusion may obscure infarct, secondary bronchopneumonia, and abscess formation with or without subsequent empyema may alter the appearance. A residual shadow resembling fibrous streaks may persist for years.

The above features, plus thinking of and looking for pulmonary infarction, will be the means of making the diagnosis. Several illustrative case histories and roentgen studies are included.—*H. G. Moehring.*

Rhodes, Paul H., and Durbin, Edgar. Coarctation of the aorta in childhood; review of the literature and report of three cases. *Am. J. Dis. Child.*, Dec., 1942, *64*, 1073–1096.

The authors' review of the literature on coarctation of the aorta revealed 47 cases in which the adult type had been diagnosed during life in children under fifteen years of age. They regard it of importance to make the diagnosis of coarctation as early in childhood as possible since the life of the patient may be prolonged by prohibiting strenuous sports and occupations. When coarctation of the aorta is pronounced enough to give clinical signs, its diagnosis is not difficult if the condition is kept in mind. It should be suspected when forceful pulsations in the neck and hypertension, particularly with a wide pulse pressure, are observed in a child. The presence of a much lower blood pressure in the lower extremities and of retardation and diminution of pulsation in the femoral arteries confirms the diagnosis. The finding of a collateral circulation and the roentgenologic signs are valuable aids.

Fray considered the most reliable single condition in the roentgenographic diagnosis to be the defect in the aortic arch seen in the left posteroanterior oblique exposure. Rhodes and Durbin have, however, encountered difficulty in outlining the aortic arch in many younger children. In adults with coarctation the aortic knob is absent in the posteroanterior view but this aortic shadow in early life is normally absent or inconspicuous. Hence this sign is not reliable in youth. Hypertrophy of the left ventricle, dilatation of the ascending aorta and erosion of the ribs can be demonstrated in some cases. It evidently requires a period of years for erosion to develop. Erosion if present is considered pathognomonic of the condition, but its absence does not rule out coarctation. In one case reported in the literature, a "double aortic knob" was demonstrated in the posteroanterior roentgenogram. This appeared as a smaller arc inside the usual arc of the aortic knob. It was believed that this second, smaller arc corresponded to the descending aorta below the stricture. Visualization with a contrast medium has been used to localize the coarctation.

If routine determinations of blood pressure in children are made on only one arm, the right arm should be used in order to avoid overlooking the occasional cases of coarctation in which the pressure is low in the left arm. Such a case is reported in this paper with interesting electrocardiographic observations.—*R. S. Bromer.*

ABDOMEN

Kraemer, Manfred, and Townsend, Leslie. Chronic gastric ulcer in a six year old child. *Am. J. Digest Dis.*, Oct., 1942, *9*, 338–340.

The authors report the case of a six year old

child in whom the roentgenological signs of a gastric ulcer were found.

Clinically, it is of interest that the patient had complained of pains in the left upper quadrant since his fifth year. Most of his pains occurred before or during breakfast. He vomited only once. His appetite was good and there were no other symptoms. There was no abdominal tenderness. There were no signs of bleeding. The roentgen examination revealed that after a teaspoonful of barium was swallowed a niche could be seen in the posterior wall in the body of the stomach. When the stomach was filled with barium the niche could not be demonstrated.

The authors suggest that roentgenological examinations in children should be performed more frequently than usual for ulcers of this kind might otherwise be overlooked.—*Franz J. Lust.*

Newman, Albert B. Peptic ulcer in childhood. *Am. J. Dis. Child.*, Oct., 1942, *64*, 649–654.

In this article 6 cases of peptic ulcer are reported. Some authors, Newman states, are inclined to emphasize the greater frequency of the disease in children of the low income groups, assuming that dietary deficiency plays a rôle in the causation of the disease. This claim, he thinks, will bear scrutiny because the studies of peptic ulcer have never been conducted on a cross section of the juvenile population but rather have been made on groups of children attending the outpatient clinics of general hospitals. Among children of the high income groups the disease will undoubtedly be found in greater frequency if it is kept in mind as one of the causes of indeterminate abdominal pain and the necessary roentgen studies are made.

The importance of focal infection in the production of peptic ulcer attracts attention by the high incidence of such ulcers associated with acute infectious disease found in the form of acute lesions in routine postmortem examinations following death from such disease. There is no doubt that the demonstrable foci of infection cannot be found in instances of peptic ulceration aside from specific ulcerations, such as those due to tuberculosis or syphilis. The generally accepted opinion is that specific bacterial infection plays little or no part in causing chronic peptic ulcer.

Regarding the general features of peptic ulcers in children, it is the experience of others that the younger group of children present the greater problem in diagnosis. Newman believes that the diagnosis of peptic ulcer in childhood is basically a roentgenographic diagnosis. The frequency with which diagnosis is made will be directly proportionate to the frequency with which roentgenograms of the gastrointestinal tract are made in suspicious cases. The evidence of the roentgenogram of a child is no different from that of an adult. Borderline situations in interpretation will occur, he states, in which the duodenal bulb may show irritability and irregularity without actual formation of craters. Where such changes persist after administration of atropine, the diagnosis is presumptive. He believes that such patients should receive routine therapy and have periodic roentgen examinations.—*R. S. Bromer.*

Eusterman, George B. Chronic nonspecific gastritis; significance as a clinical entity. *Gastroenterology*, Jan., 1943, *1*, 54–61.

The significance of chronic nonspecific gastritis as a clinical entity awaits final clarification.

Familiar types of gastritis, histologically confirmed, and observed over a period of years, are as follows: phlegmonous gastritis, acute and subacute ulcerative gastritis in association with duodenal and gastric ulcer, hemorrhagic toxic gastritis, chronic atrophic gastritis of pernicious anemia, subacute combined sclerosis, sprue, diffuse atrophic and hypertrophic gastritis secondary to disease of the circulatory, hepatic, pulmonary and incretory systems, primary chronic regional gastritis, and carcinoma simulating hypertrophic antral gastritis, postoperative diffuse and perianastomotic gastritis.

As the result of critical observation and discriminate elimination of all other intrinsic and extrinsic factors no condition other than an inflammatory disease of the gastric mucosa, that is, gastritis, could logically explain certain forms of gastric disorder that are encountered frequently. A gastroscopic examination is indicated in every case of chronic, recurring, otherwise unexplainable dyspepsia.

Simulation of the ulcer symptom complex, or hemorrhage, or both, is a frequent manifestation of hypertrophic erosive or ulcerative gastritis, one of the most important types, clinically speaking. On the other hand, gastritis in its various forms is often symptomless.

The sources of diagnostic error in the presence of gastroscopically verified gastritis are discussed.

Our knowledge of gastritis in its various aspects is still incomplete and problems of practical import awaiting solution are discussed.

Chronic nonspecific gastritis in its various forms is generally conceded to be refractory to treatment, but intensive individualized treatment at the earliest possible moment, as in the case of gastroduodenal ulcer, should lessen our pessimism in this respect.—*Franz J. Lust.*

Martin, Gustav J., Thompson, Marvin R., and de Carvajal-Forero, J. The influence of single and multiple B complex deficiencies upon the motility of the gastrointestinal tract. *Am. J. Digest Dis.*, Aug., 1942, *9*, 268–273.

The authors studied the influence of single and multiple B complex deficiencies in dogs. From a consideration of the roentgen findings it is the authors' opinion that there are features in common suggesting that the two factors, inositol and pantothenic acid, are both associated with the maintenance of gastrointestinal normality. That other factors, such as pyridoxine, may influence the general picture is illustrated by the hypotonicity in several experiments. The striking similarity of pantothenic acid and inositol deficiencies in their effect on the gastrointestinal tract is to be emphasized and suggests an interdependence of the two factors. The same features characterize the picture if either is absent from the diet. These features are: (1) increased gastric emptying time with pylorospasm; (2) marked segmentation of both the small and the large intestine; (3) general picture of hypertonicity with hypomotility; (4) alternation of ribbon-like segments with dilated loops; (5) frequent formation of gas; (6) fluid levels.

However, these findings and conclusions are in part substantiated by, and in part contradicted by, clinical and experimental data relating to the rôle of the B complex in gastrointestinal function—*Franz J. Lust.*

Horncastle, C. Winsor. Filling-defects within the barium-filled duodenal cap. *Brit. J. Radiol.*, Nov., 1942, *15*, 339–340.

A case is described in which a diagnosis of duodenitis with polyposis was based on the finding of two quite large circular filling defects in the cap of the duodenum. Their mobility was limited, there was generalized coarsening of the mucous membrane relief pattern of the cap, no constant abnormality in the position and shape of the cap which could be caused by external pressure or adhesions, melena and a mild secondary anemia.

The patient was an Indian seaman aged thirty. On waking the next morning the patient vomited and the vomitus contained an almost circular bean about a centimeter in diameter heavily coated with bile pigment. Only one translucency was now visible in the duodenal cap and this subsequently disappeared, evidently from passage of the other bean. The patient had had no beans of this type since six months before when his symptoms had begun. The beans had a very tough outer covering and had evidently lodged in the duodenal cap and caused duodenitis.—*Audrey G. Morgan.*

Sussman, Marcy L., and Wachtel, Emanuel. Factors concerned in the abnormal distribution of barium in the small bowel. *Radiology*, Feb., 1943, *40*, 128–138.

Certain roentgen abnormalities occur in the small intestine in disease. They include variations in motility and tone, dilatation of loops, abnormal segmentation, coarsening or obliteration of the mucosal folds and flocculation of the barium. This has been called the deficiency pattern and attributed to nutritional deficiency but the author has found it in other diseases, including granulomatous jejuno-ileitis, sprue, and celiac disease. It is evident that inflammation can produce a pattern that cannot be distinguished from the deficiency pattern.

The cause of these changes is not known. It has been assumed that they are due to a defect in the intramural nervous system but the author does not think from the experimental evidence that this is true. They may be produced by edema and infiltration of the submucosa, atrophy of the mucosa, muscle damage and nerve infiltration, modified perhaps by abnormal bowel content and unusual hormonal or nerve stimuli. There is some experimental evidence that the changes can be caused by deficiency of certain vitamin B components but it is not known just what components are lacking. He does not believe that there is any definite proof that these changes all have a common cause.

In the discussion Dr. Golden supported the neurogenic theory of these mucosal changes and said that he thought there must be a common factor in their causation and that it probably lay in the intramural nervous system.—*Audrey G. Morgan.*

Feldman, Maurice. A comparative roentgenologic study of the gallbladder by intensified cholecystography. *Radiology*, Dec., 1942, *39*, 697–699.

The routine eighteen to twenty-four hour cholecystographic test with single, double, or triple doses often shows only a faint shadow, or a gallbladder that is faintly outlined or not filled at all. This would indicate a pathological condition but it has been found that such pictures may be caused by other factors, such as defective technique, inadequate preparation of the patient, insufficient dye and overshadowing of the gallbladder by the colon, etc. The author recommends continuing the examination for forty-two to forty-eight hours after the first administration of the dye. If after the routine examination the gallbladder is poorly visible two doses of dye are given, one in the morning and the other in the afternoon. There should be no fat in the diet during the intensified test. At the end of eighteen to twenty-four hours after this second administration of dye a second series of roentgenograms is made, including a left oblique view. If after this second intensified examination the gallbladder is still unfilled or shows only a faint shadow there is probably some pathological condition. But in many cases the gallbladder will fill during the intensified test.

The intensified test was given in a series of 29 cases with doubtful shadows or no shadows at all. After the prolonged test 13 of these cases showed normal findings and 16 abnormal findings, which proves the great value of the intensified test.—*Audrey G. Morgan.*

Feldman, Maurice, Goodman, Jerome E., and Weinberg, Tobias. Varices of the gall bladder associated with a mucosal cyst. *Am. J. Digest. Dis.*, Dec., 1942, *9*, 399–400.

The authors report a case in which varices of the gallbladder were found. Cholecystography revealed an enlarged gallbladder shadow, of good but uneven density. There were two shallow defects close to the neck of the gallbladder which suggested the presence of neoplasms. In the fundus there was a punched out defect about 1 cm. in diameter. The gallbladder contracted following a fat meal. There was no sign of stones. The cholecystographic findings were interpreted as representing benign neoplasms.

At operation a curious and bizarre appearance of the gallbladder was observed. It was crisscrossed by dilated, tortuous, engorged veins which arose in the serosa. Another group of unusually prominent veins were noted hanging loosely from the liver bed like a bunch of grapes, spreading over the gallbladder. The cystic vein was markedly dilated. When the cystic vein was clamped, the dilated veins of the gallbladder collapsed, while those originating in the liver bed remained dilated. The liver was enlarged, extending about four fingerbreadths below the costal margin.

The gross appearance of the gallbladder showed the serosal surface wrinkled and glossy. The wall was of average thickness. The fundus showed a small mucosal cyst, measuring approximately 1 cm. in diameter. It appeared to be superficial, lying wholly within the mucosa and contained a brownish, pink-staining granular material. Within the subserosal tissues adjacent to the cyst were several enlarged veins. The remaining mucosal surface was normal. Microscopic study of the gallbladder wall showed diffusely scattered lymphocytes and polymorphonuclears. The mucosa was intact and heaped up into folds. The cyst was lined with normal mucous membrane.

The two groups of veins, the cholecystic and hepatocholecystic veins were well demonstrated in this case. The portal system was apparently not involved as there were no varicosities elsewhere.

The etiology of mucosal cyst of the gallbladder is unknown. It is believed that they originate in Luschka's ducts.—*Franz J. Lust.*

Hurwitt, Elliott S., and Arnheim, Ernest E. Meconium ileus associated with stenosis of the pancreatic ducts; clinical, pathologic and embryologic study. *Am. J. Dis. Child.*, Sept., 1942, *64*, 443–454.

The association of inspissation of meconium in the newborn resulting in obstruction of the intestine (meconium ileus) and cystic fibrosis of the pancreas was first reported by Landsteiner in 1900. The authors report a case of meconium ileus associated with stenosis of the main pan-

creatic duct and cystic fibrosis of the pancreas including histologic study of the pancreas by serial sections. They state that investigation of early embryos reveals that the pancreatic ducts, in contrast with the biliary ducts and the duodenum do not pass through a stage of occlusion by epithelial proliferation. The cause of congenital stenosis of the pancreatic ducts is a focal developmental defect. They state also that the basic lesion in meconium ileus is assumed to be interference with the passage of pancreatic enzymes into the duodenum. Farber has suggested that the inspissated meconium might be washed from the bowel by way of an enterostomy or colostomy, pancreatic extracts or duodenal juice being used as solvents. This suggestion seems to the authors to be of value in the therapy of this uniformly fatal condition, since death is due to mechanical blockade of the intestinal lumen.

The case reported is that of a boy, aged twenty-four hours, with the history of absence of passage of meconium per rectum since birth and intermittent regurgitation of bile-stained fluid for twelve hours. A roentgenogram of the abdomen, without use of a contrast medium, showed pronounced distention of the loops of the jejunum.—*R. S. Bromer.*

Solis-Cohen, Leon, and Levine, Samuel. Roentgen diagnosis of lacerated spleen. *Radiology*, Dec., 1942, *39*, 707–710.

Under war conditions roentgenograms of the abdomen should be examined carefully for evidence of injury to the spleen or liver as bomb injuries may cause rupture of internal organs without external evidence.

The clinical symptoms of lacerated spleen are those of intra-abdominal hemorrhage. This may be violent and cause early death, it may be progressive, allowing the patient to walk some distance but becoming manifest within forty-eight hours or it may be delayed with repeated bleeding at intervals of several days. Delayed splenic hemorrhage must be recognized promptly if the patient is to be saved.

Normally the shadow of the spleen can be seen on the roentgenogram in the left upper quadrant. In laceration of the spleen this shadow is obliterated. The blood also gravitates along the gastrosplenic ligament and infiltrates along the wall of the stomach, resulting in a jagged, serrated greater curvature. The extent of serration and deformity of the curvature is in direct proportion to the severity of the hemorrhage. If the hemorrhage is severe there may be an associated reflex dilatation of the stomach. These two signs are of great value in the diagnosis of lacerated spleen and in some cases perisplenic bleeding also causes tenting of the diaphragm which is an additional significant sign.

Three cases of roentgen diagnosis of lacerated spleen are described and illustrated with roentgenograms.—*Audrey G. Morgan.*

GYNECOLOGY AND OBSTETRICS

Graber, E. A., and Kantor, H. I. Direct measurement of Caldwell-Moloy x-ray plates. *Am. J. Obst. & Gynec.*, Jan., 1943, *45*, 112–116.

Some obstetricians study only architecture and consider measuring the pelvis unnecessary. The authors believe that measurements present additional information especially important in the borderline pelvis. If the obstetric conjugate, for example, is less than 9 cm., a difficult delivery may be anticipated even in a true gynecoid pelvis. The number of borderline pelves is comparatively large.

As many find it difficult to measure accurately the planes of the pelvis through a stereoscope, the authors sought a method to act as a check. This entails the routine method of taking Caldwell-Moloy roentgenograms. The only additional equipment needed is a metallic ruler which is placed between the patient's buttocks when the lateral plate is taken. The measurements of all midline diameters directly on a ruler placed in the midline is obvious. Determination of transverse measurements is based on the geometric theorum, "in similar triangles, the bases bear the same relationship to each other as the altitudes."—*Mary Frances Vastine.*

Copland, Sidney M., and Colvin, S. H., Jr. The Krukenberg tumor; critique, with report of additional four cases, including the smallest on record. *Am. J. Obst. & Gynec.*, Jan., 1943, *45*, 59–69.

Four cases of Krukenberg tumor are reported and the following conclusions are reached:

(1) The Krukenberg tumor is a primary or secondary tumor of the ovary. It is of epithelial

origin and is usually bilateral. Ascites is frequently an accompaniment.

(2) A primary Krukenberg tumor of the ovary is rare and can only be classified as such after microscopic examination of the various viscera (especially the stomach) from which it may metastasize.

(3) The typical cell in the Krukenberg tumor is the signet ring cell.

(4) The mode of metastases is most probably through the lymphatics or blood stream.

(5) The ovaries should be examined before the surgeon classifies an intestinal tract malignancy as non-metastatic.

(6) The incidence of the Krukenberg tumor seems to be increasing.

(7) The primary growth need not possess the same structure as the Krukenberg metastases in the ovary.—*Mary Frances Vastine.*

GENITOURINARY SYSTEM

BEILIN, L. M., and NEIMAN, B. H. Bilateral renal carcinoma. *J. Urol.*, Dec., 1942, *48*, 575–584.

Although bilateral Wilms tumor is not infrequent in children, bilateral primary renal carcinoma in adults is rare. The authors found 8 cases reported in the literature and added a ninth case in a fifty year old male who was admitted with complaints of hematuria and left loin pain of one week's duration. The left kidney was palpable and enlargement was revealed on the flat roentgenogram. Bilateral retrograde pyelography showed a coarse pattern of the left kidney calyces and a suggestive tumor mass in the lower pole of the right kidney. The possibility of bilateral cystic disease or neoplasm was suggested. Following recurrent attacks of hematuria and left loin pain a left nephrectomy was performed and the diagnosis of hypernephroma made.

The patient gained weight and became symptom free following operation. Six and a half years later he was again seen complaining of hematuria of one year's duration, pain in the right loin and loss of weight and appetite. A survey roentgenogram showed enlargement of the right kidney. Retrograde pyelography showed a distorted compressed kidney pelvis and a single flattened calyx, the ureter was displaced medially. The patient's clinical course became progressively worse. Autopsy revealed hypernephroma of the right kidney.

The following arguments are offered by the authors in favor of primary malignancies in each kidney rather than the lesion in one kidney being metastatic from the other: (1) no other evidence of metastasis was found: (2) direct metastasis from one kidney tumor to the other kidney is exceedingly rare, and (3) slowness of progression of the tumors which would make bone and lung metastases probable if any metastasis occurred. It is obviously impossible to be certain that one lesion was not metastatic from the other.—*R. M. Harvey.*

VITT, A. E., and MELICK, W. F. Carcinoma of the kidney and pregnancy. *J. Urol.*, Dec., 1942, *48*, 601–610.

The occurrence of renal tumors in pregnancy is rare. The relatively young age, however, of pregnant women is probably the responsible factor. The authors found in the literature 6 cases of hypernephroma of the kidney associated with pregnancy. They summarized the reports of these 6 cases and added an additional case. This occurred in a twenty-one year old white woman who had an uneventful pregnancy and post-natal course except for a transient fever which was accompanied by pain in the lumbar area and slight burning on urination. Approximately three months after discharge from the hospital the patient returned complaining of hematuria of five days' duration and left lumbar pain. A retrograde pyelogram disclosed a filling defect in the left kidney which obliterated the middle and lower calyces. Survey roentgenograms of the skeleton were negative. A nephrectomy was performed and the diagnosis of papillary adenocarcinoma was made. Postoperative irradiation was given. A subsequent pregnancy resulted in a living child sixteen months postoperatively. At this time the patient was in good health; a pyelogram of the right side was normal and there was no evidence of metastasis.

Although pregnancy is generally considered to affect adversely malignant tumors of the genital tract none of the 8 cases of renal tumor reviewed by the authors appeared to be so affected. In no case was pregnancy influenced by nephrectomy. Further pregnancies do not appear to be contraindicated providing a close watch is kept on the condition of the remaining kidney.—*R. M. Harvey.*

Fowler, H. A. Papillary carcinoma of the right kidney; report of a case with atypical history and findings. *J. Urol.*, Dec., 1942, *48*, 563–570.

This case is reported by the author because of the difficulties presented in diagnosis. The case is that of a sixty year old female who had had complaint referable to the gastrointestinal tract for three years; she had lost approximately 50 pounds in weight. Roentgen study of the gastrointestinal tract showed a ptotic stomach and a spastic colon. Because of tremor, elevated pulse rate and a plus 30 basal metabolic rate, roentgen treatment was given to the thyroid gland. The patient gained 50 pounds in the next two years but was never relieved of the gastrointestinal complaints, alternating diarrhea and constipation, bloating after meals, flatulence, anorexia and "bilious spells." At the end of this two year period the patient began to experience dizziness, weight loss and loss of appetite. At this time she first began to complain of pain in the right lower quadrant radiating toward the right kidney. Abdominal examination showed enlargement of the right kidney. Intravenous urography showed a normal left kidney and a non-functioning right kidney. Cystoscopic examination revealed an impassable obstruction of the right ureter, and an attempted right retrograde pyelogram showed an irregular collection of medium in the soft tissues lateral to the tip of the catheter. The interpretation of the author was a peri-ureteral abscess communicating with the ureter. A film exposed three hours later showed the dye to have drained from the abscess cavity into the bladder. The pyelographic diagnoses were nonfunctioning right kidney, complete stricture of the right ureter and peri-ureteral abscess communicating with the right ureter. Operations disclosed a right kidney which consisted mainly of scar tissue and two old abscess cavities. Histopathological report was papillary carcinoma. Multiple metastases occurred prior to death.

The interesting features of this case were predominance of gastrointestinal symptoms, absence of the genitourinary symptoms in the presence of advanced malignancy plus secondary infection, and the bizarre appearance of the pyelogram which revealed the presence of kidney disease but provided no specific diagnosis. —*R. M. Harvey.*

Atkinson, R. C. Skin metastases from bladder tumors. *J. Urol.*, Oct., 1942, *48*, 350–356.

According to Ewing, extension from bladder tumors is usually through the bladder wall to the pelvic tissues, up the ureters to the kidneys, or along the lymphatics to the prevertebral lymph nodes. Blood-borne metastases to the skin are very rare. The author found 4 such cases reported in the literature.

Thirty-six primary bladder carcinomas were found by the author in a series of 1,000 autopsies at Stanford University on patients dying of carcinoma. One had skin metastases. This was in a fifty-nine year old man who had had gross hematuria for four days. Prior to that he had had occasional bouts of hematuria for three years. Excretory urography showed a large filling defect in the bladder; the kidneys and ureter appeared normal. Cystographic examination showed a large ulcerating mass in the left lateral wall of the bladder. This was fulgurated and four 25 mg. radium bombs were placed in contact with the base of the lesion for fourteen hours. The pathological specimen was at first reported as a papilloma of the bladder but on subsequent examinations the diagnosis of papillary carcinoma was made.

Six weeks postoperative a metastatic lesion appeared on the upper lip. The patient died two months later with multiple skin metastases. No metastases could be demonstrated roentgenologically in the chest or bones.—*R. M. Harvey.*

McCahey, J. F., and Fetter, J. S. Intravenous urography during renal pain from ureteral stricture. *J. Urol.*, Dec., 1942, *48*, 622–627.

Urography is not considered of value in the diagnosis of ureteral stricture. The authors feel that some value may be obtained from intravenous urography in cases of ureteral stricture if the examination is performed when the patient is experiencing renal pain. They cite 2 cases to substantiate this belief. The first case was a thirty-eight year old male on whom a retrograde pyelogram showed a moderate unilateral hydronephrosis and hydroureter. Although the left ureteral meatus was edematous at cystoscopy no stone could be found. An intravenous pyelogram done several days later during an attack of renal pain showed opacification of the affected kidney on the five minute roentgenogram without evidence of dye in the

kidney pelvis. The fifteen and thirty minute roentgenograms showed an outline of the entire urinary tract on the affected side. At operation no stone could be found. The second case was that of a thirty-five year old white female who had had recurrent attacks of left renal pain. The intravenous pyelograms were normal except for slight dilatation of the lower third of the left ureter and a suggestive smaller calculus near the mouth of the left ureter. Roentgenograms taken with an opaque catheter in the left ureter showed the catheter to lie in close relationship with what had been thought to be ureteral calculus. An intravenous urogram was done two days later during an acute attack of pain. This showed a functioning kidney on the right but no visualization of dye on the left on the five minute film. On the fifteen minute film there was an opacification of the left kidney and on the thirty minute film the left urinary tract was completely outlined and showed moderate dilatation. The distal end of the left ureter was suggestive of stricture. The authors postulate that the delayed appearance of the dye in excretory urogram during periods of renal colic is due to the fact that the ureter and kidney pelvis on the affected side are filled with urine.—*R. M. Harvey.*

NERVOUS SYSTEM

Lowman, Robert M., and Finkelstein, Arthur. Air myelography for demonstration of the cervical spinal cord. *Radiology*, Dec., 1942, *39*, 700–706.

Lipiodol examination of the cervical cord has not proved very successful because of escape of the opaque material into the cranial subarachnoid pathways. But it has been found that air myelography of this part of the cord is very successful. Air could be demonstrated in the cervical part of the spinal canal in all of 50 unselected encephalograms. Air is injected in the lumbar region with the patient standing and is retained in the cervical canal because of partial obstruction at the level of the axis thought to be due to downward projection of the cerebellar tonsils through the foramen magnum which blocks the upward passage of the air.

Roentgen examination following the introduction of air is made in the lateral projection by Caldwell's method. With the patient standing the lateral aspect of the shoulder is pressed against the cassette changer or cassette. The head is fixed so that the median plane of the face is vertical and parallel to the plane of the film. The fourth cervical vertebra is opposite the center of the cassette and the central ray is projected through this point. The technical factors for the average patient with a neck 8 cm. thick are: 75 kv., 50 ma., anode-film distance 72 inches. A high speed Potter-Bucky diaphragm is used. The five upper segments are shown clearly but because detail may be obscured by the muscles of the neck in the sixth and seventh segments modified oblique views may be necessary for this region.

Diagrams and roentgenograms are given showing the individual variations in the curvature and position of this part of the cord. Three cases are described in which tumors of the cervical cord were demonstrated by this method.—*Audrey G. Morgan.*

SKELETAL SYSTEM

Franklin, Emily L., and Matheson, I. Melorheostosis; report on a case with a review of the literature. *Brit. J. Radiol.*, July, 1942, *15*, 185–191.

Melorheostosis is a rare bone condition first described in 1922 by Léri and Joanny. The authors have found 38 cases reported in the literature since that time which are briefly reviewed and they describe a case of their own in a woman of forty-one admitted to hospital on account of an ulcer of the back of the right foot. Since the age of about ten her left leg had been shorter than the right. For the past two or three years she had had extreme edema of the right leg, which was greatly enlarged and there were recurrent ulcerations on the back of the right foot. The changes characteristic of the disease were found in a large number of bones on the right side of the body and none on the left except the fifth lumbar vertebra. Both upper and lower limbs were involved, which is unusual.

In melorheostosis there is hyperostosis of the bones generally confined to either the lateral or medial side of the involved bone. It looks like molten wax flowing down the side of a candle. Roentgenograms showing the appearance are given. The microscopic appearance differs depending on the stage of the disease in which the specimens are taken. No satisfactory explanation has been found of the cause of the disease. —*Audrey G. Morgan.*

Sauer, H. R. Case of large bone metastasis from carcinoma of the ureter complicated by congenital giant hydronephrosis. *J. Urol.*, Nov., 1942, *48*, 467–473.

The author estimates that at least 189 cases of primary cancer of the ureter have been published. He reports the case of one fifty-six year old man who was admitted with complaints of intermittent right lumbar pain of two years' duration, presence of a tumor mass in the right upper abdomen for two weeks, right shoulder joint pain which had been increasing in severity for the past six weeks and three attacks of transient hematuria during the previous years. Physical examination disclosed swelling, tenderness and limitation of motion of the right shoulder girdle and the presence of a large tumor mass in the right upper abdomen. At cystoscopy no dye was recovered from either ureter following phthalein injections. Retrograde pyelogram showed no dye in either kidney but an irregular accumulation in the lower portion of both ureters. A film one hour after injection showed a normal double leftsided kidney but no dye in the right kidney. An excretory urogram three days later showed a nonfunctioning left kidney and moderate dilatation of the left lower kidney pelvis. A roetgenogram of the right shoulder girdle showed a large destructive lesion of the head and upper shaft of the right humerus. Autopsy showed a primary carcinoma of the middle third of the right ureter which had metastasized to the right humerus and to the left kidney. A reduplicated kidney pelvis and ureter was found on the left side. A massive hydronephrosis due to congenital ureteropelvic stricture was found on the right side. The middle third of the right ureter was filled with a papillary tumor which was distinct from the stricture previously mentioned. The hydronephrosis in this case was secondary to the stricture and not to the tumor. The metastatic lesion in the right humerus secondary to ureteral tumor is a clinical rarity.—*R. M. Harvey.*

Truog, C. P. Bone lesions in acquired syphilis. *Radiology*, Jan., 1943, *40*, 1–9.

The bone lesions of syphilis may imitate those of almost any other bone disease. The difficulties of differential diagnosis are illustrated by 9 cases described in this article, 8 of which are illustrated with roentgenograms. The author concludes that all cases of bone syphilis are osteomyelitis and that gumma is merely a type of syphilitic osteomyelitis in which necrosis is the outstanding finding. It should be possible by a very careful study of roentgenograms to make a differential diagnosis between syphilitic and other forms of bone disease.

The first case here described was in a Negro who attributed the pain in his shin bone to an injury. Roentgen and laboratory examinations showed a syphilitic condition in which the periosteum was chiefly involved though there was probably a low grade osteitis as well. In the second case a diagnosis of probable osteogenic sarcoma was made but a more careful study would have shown that what was thought to be transverse spicules was merely an irregularity in the periosteal proliferation. In the third case the findings were not characteristic of any form of bone tumor but the possibility of syphilitic osteomyelitis was not considered and a diagnosis of osteochondroma was made. The fourth case was one of generalized bone syphilis which resembled generalized osteolytic metastases. The fifth case was one of syphilis of the right clavicle with a draining sinus which cleared up on antisyphilitic treatment. The Kahn test was negative but it frequently is after insufficient antisyphilitic treatment. Case 6 was one of multiple osteomyelitis showing the variety of roentgen manifestations of the disease. In Case 7 microscopic examination was not satisfactory because there were no blood vessels in the specimen. It is hard to make a definite diagnosis of syphilitic osteomyelitis without perivascular lymphocyte infiltration. The eighth case was one of destructive syphilis of the clavicle which resembled metastasis but this diagnosis was ruled out by the clinical findings. Case 9 also showed the variable roentgen findings in syphilitic osteomyelitis. It resembled a generalized metastasis but the findings were not characteristic of any special form of tumor and the correct diagnosis was finally made from the roentgenograms.—*Audrey G. Morgan.*

Sullivan, T. J., Gutman, E. B., and Gutman, A. B. Theory and application of the serum "acid" phosphatase determination in metastasizing prostatic carcinoma; early effects of castration. *J. Urol.*, Oct., 1942, *48*, 426–458.

Kutscher and Wolbergs, in 1935, discovered that normal human prostatic tissue is rich in an "acid" phosphatase. This enzyme appears to be

elaborated by the prostatic glandular epithelium. It does not appear in significant concentration until puberty. Its appearance indicates physiological maturity of the glandular epithelium. The enzyme is excreted in the prostatic fluid. Its exact physiological rôle in the semen is unknown.

Gutman, Scoul and Gutman noted in 1936 that metastatic tumor cells from prostatic cancer retained their capacity to elaborate phosphatase. They found that the serum of patients with metastatic prostatic cancer contained "acid" phosphatase which was indistinguishable from prostatic tissue "acid" phosphatase. A normal value for serum "acid" phosphatase was determined to be 2.5 units of activity per 100 cc. of serum according to the authors' method of determination. Fresh non-hemolyzed sera must be used. Serum "acid" phosphatase levels were found to be elevated in other diseases, such as breast cancer in females, Paget's disease, hyperparathyroidism and osteopetrosis. The authors concluded that values above 4.5 units per 100 cc. of serum were indicative of metastasizing prostatic carcinoma and values below 3 units per 100 cc. were negative. Values between these two levels were of indeterminate significance. They used a modification of the King-Armstrong method for the determination of alkaline phosphatase to determine the serum "acid" phosphatase activity. Their unit is defined as "that degree of phosphatase activity which at pH 4.9 and 37° C. will liberate from the specified citrate buffer-monophenylphosphate substrate solution —mg. of phenol in one hour."

In order to evaluate the reliability of elevated serum "acid" phosphatase determinations as a criteria of metastatic prostatic carcinoma, the authors examined 285 patients with prostatic disease and 600 control cases. One hundred per cent of 30 normal cases showed "acid" phosphatase levels below 3 units; 15 per cent of 130 cases of prostatic carcinoma with roentgen evidence of bone metastases had levels below 3 units, and 50 per cent had levels above 10 units. The authors suggest as possible reasons for the low values in the 15 per cent of cases mentioned the following factors: (1) failure of neoplastic prostatic tissue to elaborate "acid" phosphatase which may in turn be due to immaturity of cells; (2) insufficient extension of the malignancy; (3) erroneous diagnoses, and (4) previous treatment such as castration, irradiation or estrogenic therapy which depresses the "acid" phosphatase level.

Eighty-nine per cent of 70 cases of prostatic cancer without roentgen evidence of bone metastases had "acid" phosphatase level of less than 3 units and the remaining 11 per cent levels below 5 units. The authors suggest that metastases may already be present in some of the 11 per cent of cases who had values between 3 and 5 units, although such metastases were not demonstrable roentgenologically. Adequate follow-ups might have demonstrated metastases in some of these cases.

One hundred per cent of 85 cases of benign prostatic hypertrophy and prostatitis had serum "acid" phosphatase levels within normal limits.

Occasional moderate elevations of the serum "acid" phosphatase were encountered in bone metastases from malignancies other than those of the prostate. Eighty-one per cent of 99 such cases had normal values and the remaining 19 per cent had values ranging from 3 to 10 units. The highest values were obtained in patients with bone metastases from carcinoma of the female breast. Ninety per cent of primary bone tumors in a series of 31 cases had normal "acid" phosphatase values; in the remaining 10 per cent values ranged from 3 to 5 units.

Of most interest to radiologists were the findings in Paget's disease which is the disease most apt to be confused with metastatic prostatic cancer. In 96 cases of Paget's disease 79 per cent had normal "acid" phosphatase values, 18 per cent had values from 3 to 5 units and 3 per cent from 5 to 10 units. In the cases with high "acid" phosphatase values the serum "alkaline" phosphatase values were also elevated which helps to differentiate between this disease and metastatic prostatic carcinoma.

In 9 cases of hyperparathyroidism two-thirds showed normal phosphatase levels. The remaining 3 cases had unit values of 4.3, 5.0 and 5.1. These values returned to normal following removal of the parathyroid tumors.

The authors found the following practical applications of serum "acid" phosphatase determination: (1) corroboration of the diagnosis of metastasizing prostatic carcinoma in patients with roentgen evidence where castration is contemplated and medical legal problems may arise: (2) provision of chemical evidence for or against metastases of a prostatic tumor when the roentgen evidence is inconclusive;(3) to determine the site of the primary tumor in

cases with roentgen evidence of metastases and no demonstrable primary tumor; (4) differentiation between Paget's disease and metastatic prostatic carcinoma; (5) selection of the type of therapy to be employed in patients with prostatic carcinoma, enucleation being done in the presence of a normal "acid" phosphatase and bilateral orchidectomy being done in cases with high serum "acid" phosphatase; (6) in the detection of metastases of recurrent tumors following prostatectomy, and (7) in selection of patients for treatment by estrogenic therapy and in evaluation of the results of such therapy.

Huggins and Hodges, in 1941, demonstrated the prompt reduction of serum "acid" phosphatase levels in metastatic prostatic carcinoma following estrogenic therapy for castration. This reduction was accompanied in many cases by remarkable clinical symptomatic improvement. The authors confirm the findings of Huggins and Hodges in 33 patients with prostatic carcinoma in whom castration was performed.

The conclusion reached from this study is that serum "acid" phosphatase values are consistent and specific enough to be reliable, although not of infallible diagnostic aid to the clinical and roentgenologic diagnosis of metastatic prostatic carcinoma.—*R. M. Harvey.*

Brailsford, James F. The skeleton at birth. *Brit. J. Radiol.*, Aug., 1942, *15*, 213–223.

A detailed description is given of the centers of ossification of the fetus at birth. Premature infants show decreased ossification corresponding to their lack of maturity. Major defects in the development of the fetal skeleton and evidence of certain bone dystrophies may be seen on the roentgenogram. A table is given showing the time in pregnancy when the various bones become ossified sufficiently so that they show on the roentgenogram. The bones of the skull, spine and limbs can be seen at the end of the second month of pregnancy if the uterine shadow is projected free of the pelvic bones and the shadows of the contents of the colon and rectum. Usually by the fifth month the fetal skeleton is clearly visible. Death of the fetus may occur at any time and if it dies the bones of the skull overlap.

Various abnormal conditions of the fetal skeleton are described and roentgenograms given of the skeleton of the normal full-term fetus and of various abnormalities, including osteogenesis imperfecta, in which the details of the fetal skeleton cannot be seen clearly even at term, fetus papyraceous, anencephalus, localized and complete myelocele and hydrocephalus.—*Audrey G. Morgan.*

Brailsford, James F. Chronic sub-periosteal abscess. *Brit. J. Radiol.*, Nov., 1942, *15*, 313–317.

Chronic subperiosteal abscesses are not so common as chronic central bone abscesses. The characteristic clinical signs are attacks of pain, varying in severity without localized heat, redness or swelling. If the bone is near the surface there may be swelling but the skin over it is not changed. The roentgenogram shows a localized lesion beneath the periosteum with a periosteal reaction for 2 or more inches up and down the bone. These abscesses occur chiefly in long bones. New periosteal bone is formed which at first is less dense than the normal cortex but gradually the latter seems to be absorbed into the new tissue which becomes dense till there is no line of demarcation between the normal and new bone. In small bones the reaction may extend entirely around the bone, while in larger ones it extends only part of the way. The bone may be twice as large as normal. Resection of the involved part of the cortex usually brings about healing.

Jaffe and Lichtenstein have described such lesions as osteoid-osteomas but there is no known benign tumor of bone that produces reaction distal to the wall of the tumor.

Six cases are described and illustrated with roentgenograms. One of the patients was a congenital syphilitic and the lesion was thought to be a gumma. It did improve to some degree under antisyphilitic treatment. In 1 case a pure culture of *Bacillus typhosus* was obtained and in 3 cases staphylococci were cultivated from the central bone.—*Audrey G. Morgan.*

Zimmermann, Carl A. W. Osteopetrosis (Albers-Schönberg disease), with case report. *Radiology*, Feb., 1943, *40*, 155–162.

The case of osteopetrosis described is said to be the 120th case reported. The patient was a boy of nine who complained that his face was crooked. He had had a large head at birth. He was much smaller than a friend of the same age and was totally deaf on the left side. His intelligence was normal. Roentgen examination showed the typical abnormal density of bone throughout the skeleton. In the skull there was

no evidence of pneumatization of the sinuses. There were no fractures though pathological fractures are frequent in this disease. The nasal bones were so thick that the respiratory lumen was obstructed and caused post-nasal clearing noises which probably led to the two adenoid operations to which the boy had been subjected.

The cause of the unbridled calcium metabolism in this disease is not known. Blood chemistry studies show no characteristic abnormality. Death is usually caused by hydrocephalus, complications following bone injuries or intercurrent disease. Few of the patients have reached an advanced age and there is no effective treatment. The frequent anemia is due to encroachment of the calcium on the bone marrow. The thickened skull bones exert pressure on the structures inside the skull which may cause hebetude, hydrocephalus, headache, vomiting or paralysis of cranial nerves, resulting in blindness, facial palsy or deafness.—*Audrey G. Morgan.*

Bickel, William H., Ghormley, Ralph K., and Camp, John D. Osteogenesis imperfecta. *Radiology*, Feb., 1943, *40*, 145–154.

The authors discuss 40 cases of osteogenesis imperfecta seen at the Mayo Clinic. Eleven were of the hereditary type and the balance of the non-hereditary congenital type. The characteristic features of this disease are brittle bones, blue sclera and osteosclerosis. The cause is not known but it is probably some defect in the germ plasm. There were multiple fractures in all of these cases but one. Deafness occurred in 45.4 per cent of the hereditary type and 17.3 per cent of the non-hereditary type.

The skull usually showed a typical roentgen picture with thin cortex and only islands of dense bone. There were many wormian bodies, especially around the lambdoid and coronal sutures. In the spinal column there was softening of the vertebrae with flattening and wedging of the bodies and ballooning of the interverbetral discs. The long bones showed a thin porotic cortex and enlarged marrow cavity. The shafts were generally bowed. Small long bones such as the fibulae and ribs sometimes appeared in the roentgenogram as mere wisps of bone. In 7 cases of the hereditary type the roentgen findings were not typical. The bones were normal or only slightly porotic. These patients were aged thirty-two to fifty-four years.

There is no known specific treatment for the disease. Subcutaneous injections of thymic extract were given in 6 of these cases without marked effect.—*Audrey G. Morgan.*

Johnstone, A. S. A case of osteochondritis in the sesamoid of the second metatarsal. *Brit. J. Radiol.*, Nov., 1942, *15*, 337–338.

The author believes that no case of osteochondritis in the sesamoid of the second metatarsal has ever been described before. The patient was a hospital sister thirty-two years of age who complained of slight pain and tenderness of the sole of the right forefoot, aggravated by standing and relieved by rest. There was localized tenderness over the plantar surface of the second metatarsal. A roentgenogram April 22, 1940, showed some flattening of the sesamoid bone. There was a dense area in the center surrounded by a translucent ring. Outside this the edges were irregular and beginning to show fragmentation. The corresponding sesamoid in the left foot was abnormally but uniformly dense. Roentgenograms in May and July of the same year showed the fragments more clearly defined and the translucent areas around them wider. Treatment consisted of wearing a pressure pad. Roentgenograms in February, 1942, showed reconstruction of bone in the affected sesamoid. The bone now showed uniform density. The appearance of the left sesamoid was unchanged. The diagnosis was confirmed by the restoration of bone structure after passing through the various stages of osteochondritis. The unchanged appearance of the left sesamoid for two years argues against avascular necrosis as the cause of this case. It was probably caused by slight, frequently repeated trauma.—*Audrey G. Morgan.*